Evaluation and Recommended Determination of a Resource Management Plan (RMP)

TITLE OF RMP:	Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component
RMP PROVIDED BY:	Puget Sound Treaty Tribes, Washington Department of Fish and Wildlife
FISHERIES:	Strait of Juan de Fuca, Hood Canal, and Puget Sound salmon fisheries and steelhead net fisheries potentially impacting listed Puget Sound chinook salmon
EVOLUTIONARILY SIGNIFICANT UNIT AFFECTED:	Puget Sound Chinook Salmon
ESA 4(d) TRACKING NUMBER:	NWR/4d/06/2003/001
DATE:	MAY 19, 2003

Background:

On March 24, 1999, National Marine Fisheries Service (NMFS) listed the Puget Sound chinook salmon (*Oncorhynchus tshawytscha*) as a threatened species under the Endangered Species Act of 1973 (64 FR 14308). The Puget Sound chinook salmon Evolutionarily Significant Unit[1] (ESU) includes all naturally spawned populations of chinook salmon from rivers and streams flowing into Puget Sound from the Elwha River, eastward. Major river systems within the ESU supporting chinook salmon populations include the Nooksack, Skagit, Stillaguamish, Snohomish, Cedar, Duwamish/Green, Puyallup, Nisqually, Skokomish, Dosewallips, Dungeness, and Elwha Rivers. Chinook salmon (and their progeny) from the following hatchery stocks are also listed under the Endangered Species Act of 1973 (ESA): Kendall Creek; North Fork Stillaguamish River; White River; Dungeness River; and Elwha River.

On July 10, 2000, NMFS issued a rule under section 4(d) of the ESA (referred hereafter as the 4(d) Rule), establishing take prohibitions for 14 salmon and steelhead ESUs, including the Puget Sound chinook salmon ESU (65 FRN 42422). The 4(d) Rule provided limits on the application of the take prohibitions, i.e., take prohibitions would not apply to the plans and activities set out in the rule if those plans and activities met the rule's criteria. One of those limits (Limit 6) applies to joint tribal and state RMPs.

[1] An Evolutionarily Significant Unit or "ESU" is a distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout.

The Puget Sound Treaty Tribes and the Washington Department of Fish and Wildlife (co-managers) submitted an RMP to NMFS in 2001 for salmon fisheries in the greater Puget Sound area. NMFS issued its determination on the RMP on April 27, 2001 (Table 1). The determination on the 2001 RMP was effective for two years so that NMFS and the co-managers could continue to monitor and evaluate the impacts of fisheries on the Puget Sound chinook salmon ESU. As recovery strategies are developed, NMFS and other resource managers will need to adapt various harvest activities that impact the ESUs. NMFS also has considered the impacts of salmon fisheries on this ESU in several other ESA section 7 consultations (Table 1).

On February 21, 2003, the co-managers provided NMFS a RMP for the 2003 fishing season, May 1, 2003, through April 30, 2004. The RMP dated February 19, 2003, is titled the "Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component" (PSIT and WDFW 2003). The 2003 RMP provides the structure through which tribal and state jurisdictions will jointly manage Puget Sound salmon fisheries and the steelhead net fisheries that may affect listed Puget Sound chinook salmon.

This document is NMFS, Northwest Region's Sustainable Fisheries Division evaluation of and recommended determination on whether the one-year RMP addresses the criteria outlined in Limit 6 of the ESA 4(d) Rule and whether it appreciably reduces the likelihood of survival and recovery of the Puget Sound chinook salmon ESU.

Evaluation:

The ESA 4(d) Rule for the Puget Sound chinook salmon ESU states that the prohibitions of paragraph (a) of the rule (16 U.S.C. 1531-1543) do not apply to actions taken in compliance with a RMP jointly developed by the States of Washington, Oregon and/or Idaho and the Tribes, provided that:

> (1) The Secretary has determined pursuant to 50 CFR 223.209 (Tribal 4(d) Rule) and the government-to-government processes therein that implementing and enforcing the joint tribal/state plan will not appreciably reduce the likelihood of survival and recovery of affected threatened ESUs.
>
> (2) In making the determination for a RMP submitted under Limit 6, the Secretary of Commerce has taken comment on how any fishery management plan addresses the criteria described under Limit 4 (Sec. 223.203(b)(4)) of the ESA 4(d) Rule (50 C.F.R. 223.203(b)(6)).

Regarding the first element, NMFS consulted with the Puget Sound Treaty Tribes during the development of the 2003 RMP through government-to-government meetings and technical workshops. These occasions provided the opportunity for NMFS to provide technical assistance, exchange information, and discuss what would be needed to provide for the conservation of listed species and to be consistent with legally enforceable tribal rights and with the Secretary of Commerce's tribal trust responsibilities. Regarding the second element, the following is an evaluation of whether the 2003 RMP adequately addresses the criteria specified in Limit 4, section (b)(4) of the ESA 4(d) Rule for the Puget Sound chinook salmon ESU.

Table 1. Summary of NMFS ESA decisions on the impacts of Puget Sound salmon fisheries on listed Puget Sound chinook salmon.

Method	Title/Citation	Coverage Dates
Biological Opinion, Issued November 18, 1999	Endangered Species Act - Reinitiated Section 7 Consultation- Biological Opinion - Approval of the Pacific Salmon Treaty by the U.S. Department of State and Management of the Southeast Alaska Salmon Fisheries Subject to the Pacific Salmon Treaty. (NMFS 1999)	November 18, 1999, through December 31, 2010
Biological Opinion, Issued April 28, 2000	Effects of Pacific Coast Ocean and Puget Sound Salmon Fisheries During the 2000-2001 Annual Regulatory Cycle (NMFS 2000a)	May 1, 2000, to April 30, 2001
Limit 6, ESA 4(d) Rule Determination, Issued April 27, 2001	Joint State Tribal RMP Provided by the Washington Department of Fish and Wildlife and the Puget Sound Tribes for Salmon Fisheries Affecting Puget Sound Chinook Salmon Under Limit 6 of the 4(d) Rule - Determination Memorandum (NMFS 2001a)	May 1, 2001, to April 30, 2003

Section (b)(4)(i) Clearly defines its intended scope and area of impact.

The Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component guides the implementation of salmon fisheries and steelhead net fisheries under the co-managers' jurisdiction that may affect Puget Sound chinook salmon in Washington waters from the mouth of the Strait of Juan de Fuca at Cape Flattery, eastward. This geographic scope (referred hereafter as the Puget Sound Action Area) encompasses the area included in the Puget Sound chinook salmon ESU, as well as the western portion of the Strait of Juan de Fuca within the United States (Figure 1). NMFS evaluated the co-manager's one-year RMP for the fishing season from May 1, 2003, through April 30, 2004.

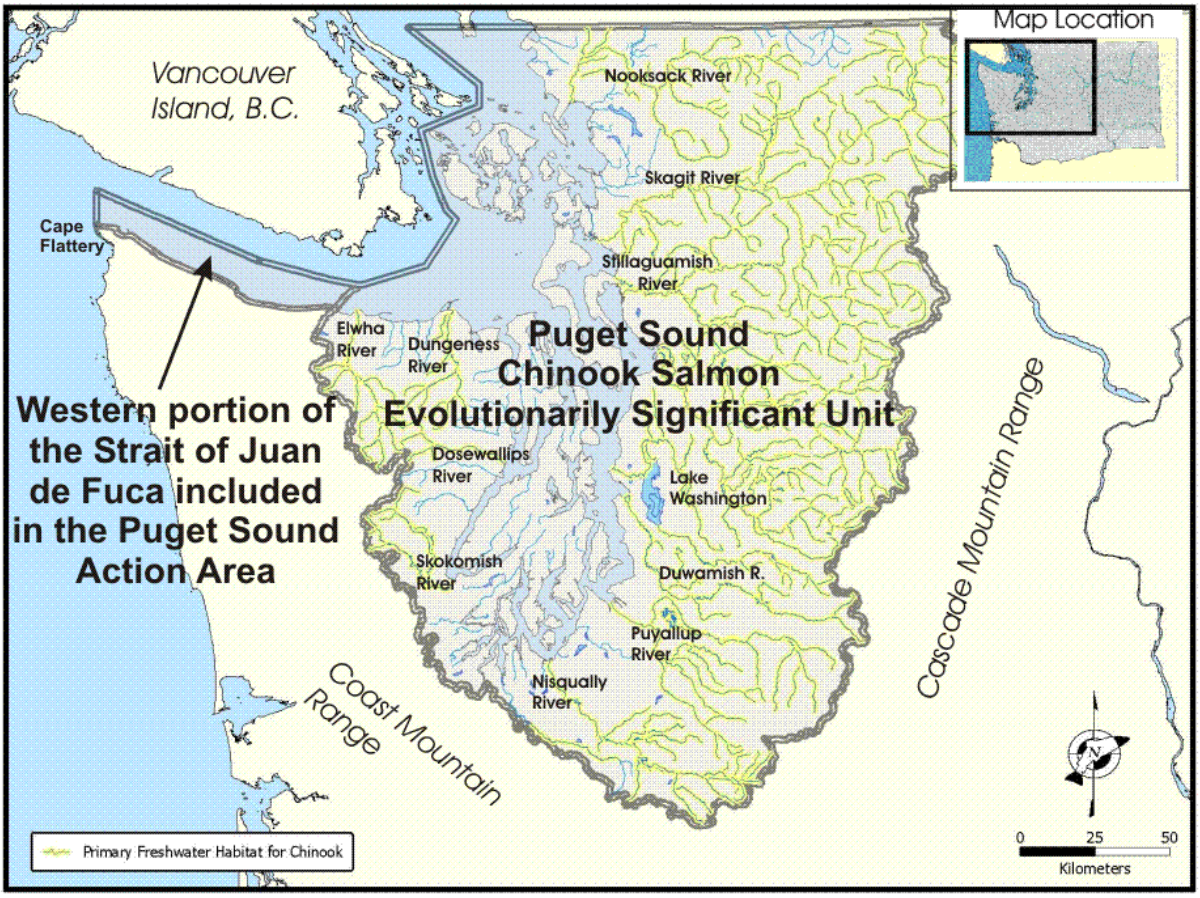

Figure 1. Puget Sound Action Area, which includes the Puget Sound chinook salmon Evolutionarily Significant Unit and the western portion of the Strait of Juan de Fuca in the United States.

Section (b)(4)(i) Sets forth the management objectives and the performance indicators for the plan.

The 2003 RMP's primary objective is to manage "harvest of strong salmon stocks to ensure that fishery-related mortality will not impede recovery of the productivity, abundance, and diversity of natural Puget Sound chinook salmon populations…" (page 7 of the 2003 RMP). The co-managers propose to achieve this objective by limiting the adverse effects on these populations.

Other objectives of the co-managers' management plan are listed on page 7 and page 8 of the 2003 RMP and include: (1) conserve the productivity, abundance, and diversity of all populations within the Puget Sound chinook salmon ESU; (2) manage salmon and steelhead fisheries for risk and uncertainty; (3) account for all sources of fishery-related mortality (including non-landed mortality); (4) follow the principles of the Puget Sound Salmon Management Plan (PSSMP 1985) and other legal mandates pursuant to *U.S. v. Washington* Civ. No. C70-9213 (W.D. Wash.), see 384 F. Supp. 312 (W.D. Wash. 1974) and *U.S. v. Oregon*; (5) follow the provisions in the 1999 Annex IV, Chapter 3, Chinook Salmon of the Pacific Salmon Treaty (PST 1999); and (6) protect Indian treaty rights.

Performance Indicators:

The 2003 RMP identifies 25 chinook salmon populations. Twenty-four populations are within the Puget Sound chinook salmon ESU, and one population (the Hoko River) is located in the western portion of Strait of Juan de Fuca (Figure 2). These populations are annually monitored by the co-managers and their status will be used as the performance indicators for the 2003 RMP.

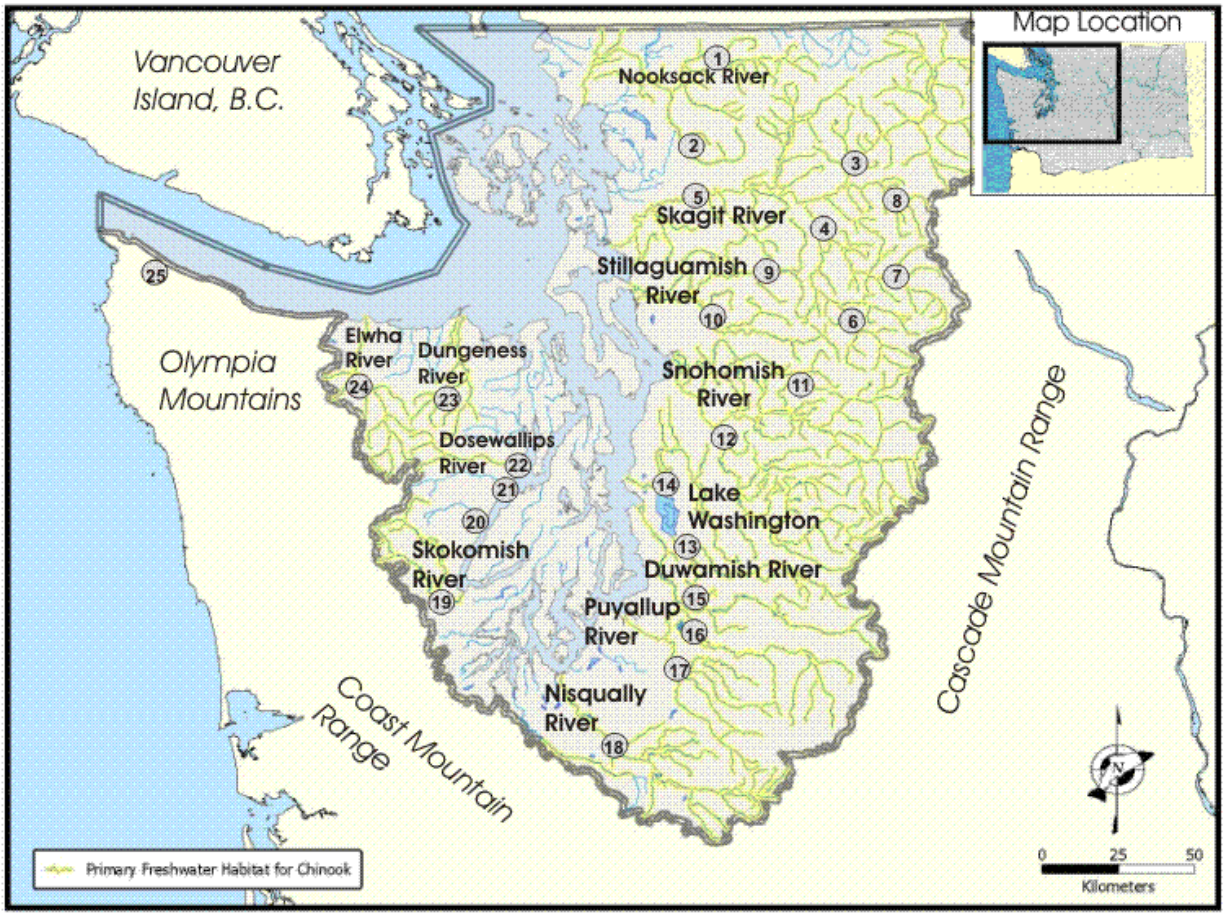

Figure 2. Location of the 2003 RMP's salmon populations within the Puget Sound Action Area. One salmon population identified in the 2003 RMP, the Hoko River (25), is not within the Puget Sound chinook salmon ESU.

For harvest management purposes, the 2003 RMP has 15 management units (Table 2). The 2003 RMP defines a management unit as a "stock or group of stocks which are aggregated for the purpose of achieving a management objective" (page 67 of the 2003 RMP). Seven of the fifteen management units contain more than one population, as defined by the co-managers (Table 2).

The 2003 RMP is based on limits to the cumulative fishery-related mortality to each Puget Sound chinook salmon population or management unit. The limits are expressed as: (1) a recovery exploitation rate; (2) an interim escapement goal; (3) a critical abundance threshold; and (4) as a minimum fishery regime exploitation rate (Table 2).

(1) Recovery Exploitation Rate:

The co-managers define exploitation rate as the total "mortality in a fishery or aggregate of fisheries expressed as the proportion of the un-fished cohort removed by fishing" (page 67 of the 2003 RMP). The 2003 RMP's recovery exploitation rates are ceilings, not to be exceeded. The co-managers propose that exploitation rates at or below these 2003 RMP's recovery exploitation rate ceilings will not impede the ability of the populations to recover.

Calculating a recovery exploitation rate ideally requires knowledge of a spawner-recruit relationship based on escapement, age composition, coded-wire-tagged distribution, environmental parameters, and management error (N. Sands, NMFS - Northwest Fisheries Science Center (NWFSC), pers. com., to K. Schultz, NMFS, March 5, 2003). For the few management units with adequate databases (Skagit Summer/Fall, Skagit Spring, Stillaguamish, and Snohomish Management Units), the 2003 RMP's recovery exploitation rates are calculated by the co-managers to: (1) result in escapements levels that are less than the point of instability[2] no more than five percent more often than the results if no harvest had occurred *and* either (a) a high probability (at least 80 percent) of the spawning escapement increasing in 25 years to a specified threshold **or** (b) the percentage of escapements less than this threshold level at the end of 25 years differed from a no harvest regime by less than 10 percent (page 21 of the 2003 RMP).

Unfortunately, a spawner-recruit relationship database is not yet available for most populations. For the Lake Washington, Skokomish, and Mid-Hood Canal Management Units, the 2003 RMP's recovery exploitation rate ceilings are generally established at the low level of exploitation rates observed in the late 1990s. Overall, since the establishment of these lower levels of exploitation rates, the Puget Sound chinook salmon escapements in these management units have shown a stable to increasing spawning escapement trend. In these cases, a pre-terminal (PT) exploitation rate of 15 percent in the southern United States (SUS) Puget Sound-area fisheries is established as the ceiling. The co-managers set the 2003 RMP's recovery exploitation rate ceiling at a SUS exploitation rate of 10 percent for those management units where very low or no terminal harvest impact occurs (Dungeness, Elwha, and the Western Strait of Juan de Fuca Management Units).

[2] The co-managers define the point of instability as "that level of population abundance (i.e., spawning escapement) which incurs substantial risk to genetic integrity, or expose the stock to depensatory mortality factors" (page 68 of the 2003 RMP).

Table 2. The 2003 RMP's Management objectives (recovery exploitation rate ceilings, interim escapement goals, critical abundance thresholds, and the range of expected exploitation rates with the implementation of minimum fishery regime), by management units and populations.

Management Unit	Population [1]	Recovery Exploitation Rate [2] (ceiling)	Interim (Reference) Escapement Goal	Critical (Low) Abundance Threshold	Range of expected exploitation rates [2] with the implementation of minimum fishery regime
Nooksack		-	4,000	-	5% to 9% SUS
	North Fork Nooksack River	-	-	1,000 [3]	-
	South Fork Nooksack River	-	-	1,000 [3]	-
Skagit Summer/Fall		52%	14,900	4,800	25% to 33%
	Upper Skagit River	-	-	2,200	-
	Lower Sauk River	-	-	400	-
	Lower Skagit River	-	-	900	-
Skagit Spring		42%	3,000	576	21% to 27%
	Upper Sauk River	-	-	-	-
	Suiattle River	-	-	-	-
	Upper Cascade River	-	-	-	-
Stillaguamish		25%	2,000	650 [3]	12% to 16%
	North Fork Stillaguamish River	-	-	500 [3]	-
	South Fork Stillaguamish River	-	-	-	-
Snohomish		24%	5,250	2,800 [3]	18% to 26%
	Skykomish River	-	-	1,745 [3]	-
	Snoqualmie River	-	-	521 [3]	-
Lake Washington		15% PT SUS	1,550	-	9% to 15% PT SUS
	Cedar River	-	1,200	200 [3]	-
	North Lake Washington Trib.	-	-	-	-
	(Bear Creek Index Area)	-	350	-	-
Green	Green River	15% PT SUS	5,800	1,800	7% to 15% PT SUS
White River	White River	20%	1,000	200	12% to 14%
Puyallup	Puyallup River	50%	-	500	36% to 46%
	(South Prairie Creek Index Area)	-	500	-	

Nisqually	Nisqually River	-	1,100	-	- [4]
Skokomish	Skokomish River	15% PT SUS	3,650 [5]	1,300 [6]	11% to 15% PT SUS
Mid-Hood Canal		15% PT SUS	750	400	11% to 15% PT SUS
	Hamma Hamma River	-	-	-	-
	Duckabush River	-	-	-	-
	Dosewallips River	-	-	-	-
Dungeness	Dungeness River	10% SUS	925	500	5% to 10% SUS
Elwha	Elwha River	10% SUS	2,900	1,000	5% to 10% SUS
Western Strait of Juan de Fuca	Hoho River	10% SUS	850	500	5% to 10% SUS

1 Populations are consistent with the populations preliminarily recognized by the Puget Sound Technical Recovery Team (TRT) within the Puget Sound chinook salmon ESU, with the exception of the Hamma Hamma and Duckabush Rivers in the Mid-Hood Canal Management Unit. The Western Strait of Juan de Fuca Management Unit is not within the Puget Sound chinook salmon Evolutionarily Significant Unit.

2 Exploitation rates are expressed as either total, southern United States (SUS), or pre-terminal southern United States (PT SUS).

3 All numbers are in natural-origin spawners.

4 The Nisqually Management Unit is managed to achieve a 1,100 natural spawner escapement goal.

5 Skokomish Management Unit's escapement goal of 3,650 spawners is composed of 1,650 natural-origin spawners and 2,000 hatchery-origin spawners.

6 Skokomish Management Unit's critical escapement threshold of 1,300 spawners is composed of 800 natural-origin spawners and 500 hatchery-origin spawners.

(2) Interim Escapement Goal:

The 2003 RMP includes interim escapement goals (sometimes referred to as the interim reference escapement goals in the 2003 RMP) for all populations or management units (see Table 2). The co-managers define the interim escapement goal as the "interim upper boundary" of the range of viability[3] (page 56 of the 2003 RMP), a point where the population has a very low probability of extinction. The 2003 RMP's interim escapement goals establish the upper escapement thresholds of the co-manager's management objectives.

The technical basis for the 2003 RMP's interim escapement goals vary among management units (see footnotes on Table 14, page 57 of the 2003 RMP). In some cases interim escapement goals are an historical average of escapement from a base period of relatively high abundance. However, habitat in many of the systems within the action area has been severely degraded. The quality and quantity of freshwater, estuarine, and near shore marine habitats are key factors in determining the potential productive capacity of any river system. Until habitat can be restored and estimates of maximum sustainable yield developed consistent with recovered habitat conditions, the ultimate productive capacity for many of the river systems in the action area remains unknown.

(3) Critical Abundance Threshold:

The 2003 RMP includes a critical abundance threshold (referred to as the low abundance threshold in the 2001 RMP) for each population or management unit (see Table 2). The co-managers define the critical abundance threshold as a "spawning escapement level below which the co-managers will exercise maximum regulatory effect to minimize fishery-related mortalities and maximize spawning escapement" (page 67 of the 2003 RMP). The co-managers state that these thresholds are based on the best available information and "set above the level at which a population may become demographically unstable, or at risk to loss of genetic integrity."

(4) Minimum Fisheries Regime Exploitation Rate

During the pre-season process (March through April), once chinook salmon adult abundance estimates for the upcoming season are available to the co-managers for all populations of concern, the co-managers will model (using the Fishery Regulation Assessment Modeling program) the Minimum Fisheries Regime outlined in Appendix C of the 2003 RMP. The resulting minimum fishery regime exploitation rate will be applied in 2003 on an individual management unit by the co-managers when the forecast abundance for any management unit is anticipated to fall below the critical abundance threshold. When imposed, the minimum fishery regime exploitation rate is a ceiling, not to be exceeded.

The methods used by the co-managers to derive the 2003 forecast abundance estimates vary by management units. Some methods are fairly comprehensive. As an example, for the Skagit River return of natural spring chinook salmon, the co-managers' methodology begins with an

[3] The 2003 RMP defines viable as a "descriptor of a salmon population that has a negligible risk of extinction over a 100-year time frame due to threats from demographic variations, local environmental variations, or threats to genetic diversity" (page 70 of the 2003 RMP).

examination of the expected age composition of returning spring chinook. The proportion of each age class in the 2003 return is then calculated. Based on this analysis, the total estimated return to the Skagit River is derived by adding the number of chinook salmon predicted to return as 3-year olds in 2003 (from the 2000 brood year), the number of chinook salmon forecast to return as 4-year olds (from the 1999 brood year), and the forecast 5-year old chinook return (from the 1998 brood year). In Puget Sound, production is generally dominated by age-four adults. Other methods used to derive the 2003 forecast abundance are less sophisticated, and rely on recent abundance averages.

The minimum fisheries regime exploitation rates that have been predicted in recent years are currently represented as a range in NMFS' evaluation and in the 2003 RMP. The actual point estimate of the minimum fishery regime exploitation rate ceiling in 2003 for each management unit will depend on the forecast abundance and its relative abundance to other chinook salmon populations. The co-managers expect that the actual 2003 point estimate will fall within the range of minimum fishery regime exploitation rates depicted in Table 2, but will be dependent on the relative abundance and the 2003 exploitation rates in Canadian fisheries. Should the actual point estimate fall outside the expected range, the co-managers will consult with the NMFS.

As required in section (b)(6)(iii) of the 4(d) Rule, the RMP must also adequately address the following nine criteria under Limit 4 section (b)(4)(i):

(1) Section (b)(4)(i)(A) Defines populations within affected Evolutionarily Significant Units, taking into account: spatial and temporal distribution genetic and phenotypic diversity, and other appropriate identifiably unique biological and life history traits.

The 2003 RMP identifies 15 management units containing the 25 populations (see Table 2). The co-managers' population designations were originally based on the Salmon and Steelhead Stock Inventory and Assessment (WDF *et al.* 1993), which identified populations based on differences in biological characteristics, genetic similarity, life history traits and geographic separation. The populations identified in the 2003 RMP correspond to the stocks described in the Salmon and Steelhead Stock Inventory and Assessment with three major differences: (1) the 2003 RMP excludes most non-native or introduced populations; (2) the 2003 RMP recognizes four Hood Canal chinook salmon populations (Duckabush, Dosewallips, Hamma Hamma, and Skokomish Rivers) rather than the single population defined in the Salmon and Steelhead Stock Inventory and Assessment document; and (3) the 2003 RMP recognizes two Snohomish River chinook salmon populations (Skykomish and Snoqualmie Rivers) rather than the four populations defined in the Salmon and Steelhead Stock Inventory and Assessment document (Snohomish Summer, Snohomish Fall, Wallace River Summer/Fall (primarily hatchery-origin), and the Bridal Veil Creek Fall populations).

The Puget Sound Technical Recovery Team[4] (TRT) has also completed a preliminary analysis of the population structure of chinook salmon within the Puget Sound chinook salmon ESU. For populations within the ESU, as of January 8, 2003, the TRT has narrowed the earlier population delineation offered by the Salmon and Steelhead Stock Inventory and Assessment to 22

[4] The Puget Sound Technical Recovery Team (TRT) is an independent scientific body convened by NMFS to develop technical delisting criteria and guidance for salmon delisting in Puget Sound.

demographically independent populations representing the primary historical spawning areas of chinook salmon (M. Ruckelshaus, chair, Puget Sound TRT, pers. com., with K. Schultz, NMFS, January 8, 2003, NMFS 2002a).

The TRT reviewed several sources of information in deriving the preliminarily recognized delineations. These sources of information include geography, migration rates, genetic attributes, patterns of life history and phenotypic characteristics, population dynamics, environmental and habitat characteristics (NMFS 2001b). A comparison between the 2003 RMP's delineation of populations within the ESU and the Puget Sound TRT preliminarily recognized populations is provided in Table 3.

Table 3. Comparison of the 2003 RMP's population within the ESU and the Puget Sound TRT's preliminarily recognized salmon populations.

2003 RMP's Management Unit	**2003 RMP's Populations**	**As of January 8, 2003, TRT's Preliminarily Recognized Populations**
Nooksack	North Fork Nooksack River South Fork Nooksack River	North Fork Nooksack River South Fork Nooksack River
Skagit Summer/Fall	Upper Skagit River Lower Sauk River Lower Skagit River	Upper Skagit River Lower Sauk River Lower Skagit River
Skagit Spring	Upper Sauk River Suiattle River Upper Cascade River	Upper Sauk River Suiattle River Upper Cascade River
Stillaguamish	North Fork Stillaguamish River South Fork Stillaguamish River	North Fork Stillaguamish River South Fork Stillaguamish River
Snohomish	Skykomish River Snoqualmie River	Skykomish River Snoqualmie River
Lake Washington	Cedar River North Lake Washington Trib.	Cedar River North Lake Washington Trib.
Green	Green River	Green River
White	White River	White River
Puyallup	Puyallup River	Puyallup River
Nisqually	Nisqually River	Nisqually River
Skokomish	Skokomish River	Skokomish River
Mid-Hood Canal	Hamma Hamma River Duckabush River Dosewallips River	-*Not Recognized as an Independent Population* - - *Not Recognized as an Independent Population* - Dosewallips River
Dungeness	Dungeness River	Dungeness River
Elwha	Elwha River	Elwha River
Western Strait of Juan de Fuca	Hoko River	- *Not within the Evolutionarily Significant Unit* -

Within the ESU, the only difference between the 2003 RMP's populations and the TRT's preliminarily recognized populations as of January 8, 2003, occurs within the Mid-Hood Canal Management Unit. The 2003 RMP's populations within this management unit include the Hamma Hamma, Duckabush, and the Dosewallips Rivers. As of January 8, 2003, the TRT

currently recognized only one population, the Dosewallips River. The physical characteristics of Dosewallips River basin is unique, as it is the only river in Hood Canal that occurs in the snowmelt-transition hydroregion (see page 55 of NMFS 2002b). NMFS, Sustainable Fisheries Division, has based its proposed evaluation of the 2003 RMP on the population delineations as preliminarily recognized by the TRT. However, even these population designations should be considered preliminary and may be revised based on additional information or findings of the Puget Sound TRT.

It is not clear to what extent the chinook salmon spawning (regularly or occasionally) in smaller independent tributaries are demographically linked to the independent populations identified. The TRT recognizes that further work is needed to determine the relationship of chinook salmon that regularly utilize other systems not identified within the boundaries of independent populations, such as the Hamma Hamma and Duckabush Rivers, to the overall population structure of the ESU (see page 56 of NMFS 2002b).

The numbers of chinook salmon in all three mid-Hood Canal systems (Hamma Hamma, Duckabush, and the Dosewallips Rivers) were not thought to be great in any one stream prior to supplementation, which was initiated in the early 1900s. The role of the undefined spawning aggregations in the adjacent Hamma Hamma and the Duckabush Rivers in recovery and their relationship with the Dosewallips River population may be clarified as further information becomes available. Because it is possible that production in the Hamma Hamma and the Duckabush Rivers may contribute to the stability of the Dosewallips River population, NMFS' assessment of the impacts of the 2003 RMP on the Dosewallips River population should be considered conservative. In the meantime, all populations that may be identified as important by the TRT for recovery of the Puget Sound chinook salmon ESU are included in this one-year RMP.

To assist the co-managers in analyzing their management actions, the 2003 RMP categorizes each chinook salmon population according to the population's life history and production characteristics. This categorization method assigns populations to one of the following three watershed based categories:

Category 1: Category 1 watersheds are areas where populations are genetically unique and indigenous to Puget Sound. Maintaining genetic diversity and integrity, and achieving abundance levels for long-term sustainability are the highest priorities for these populations. The management objective for Category 1 populations is to protect and recover these indigenous populations. The intent is to rebuild and manage for natural production. The co-managers will manage fisheries to meet the interim escapement goal and/or the recovery exploitation rates for Category 1 populations based on the co-managers' understanding of natural chinook salmon production requirements for the population. The co-managers designated 17 populations within the ESU as Category 1 (Table 4).

The status of Category 1 populations within the ESU varies. Some populations have fallen to such low levels that the ability to maintain their genetic diversity may be at risk. In some cases, without hatchery operations, populations would likely decline to very low levels. In one case at least, the number of hatchery-origin fish spawning naturally may be a concern, in part because it

may be masking the ability to evaluate the actual productivity of the natural-origin population. Other populations are more robust and the abundance levels are above what is needed to sustain genetic diversity, but often not at levels that will sustain maximum yield.

Category 2: Category 2 watersheds are areas where indigenous populations may no longer exist, but where sustainable populations existed historically. The co-managers believe that natural production is possible in Category 2 populations given suitable or productive habitat. The level of natural spawning in these streams may largely reflect production and escapement (straying) of hatchery origin fish. The objective for Category 2 populations is to use the most locally-adapted population to reestablish naturally-sustainable populations. Five Category 2 populations within the ESU have been identified by this management plan (Table 4).

Table 4. The 2003 RMP's assigned categories and run timing of the chinook salmon populations within the ESU.

2003 RMP's Management Unit	**TRT Preliminarily Recognized Populations**	**2003 RMP's Assigned Population Category**			**Run Timing**
		1	**2**	**3**	
Nooksack	North Fork Nooksack River	**X**			Early
	South Fork Nooksack River	**X**			Early
Skagit Summer/Fall	Upper Skagit River	**X**			Summer
	Lower Sauk River	**X**			Summer
	Lower Skagit River	**X**			Fall
Skagit Spring	Upper Sauk River	**X**			Spring
	Suiattle River	**X**			Spring
	Upper Cascade River	**X**			Spring
Stillaguamish	North Fork Stillaguamish River	**X**			Summer
	South Fork Stillaguamish River	**X**			Fall
Snohomish	Skykomish River	**X**			Summer/Fall
	Snoqualmie River	**X**			Summer/Fall
Lake Washington	Cedar River	**X**			May through
	North Lake Washington Tributary		**X**		early November
Green	Green River	**X**			Fall
White	White River	**X**			Spring
Puyallup	Puyallup River		**X**		Fall
Nisqually	Nisqually River		**X**		Fall
Skokomish	Skokomish River		**X**		Fall
Mid-Hood Canal	Dosewallips River		**X**		Summer/Fall
Dungeness	Dungeness River	**X**			Summer
Elwha	Elwha River	**X**			Summer

Category 2 populations are primarily found in southern Puget Sound and Hood Canal where hatchery production has been used extensively to mitigate for natural production lost to habitat degradation. Historically these areas were managed for hatchery production. Comanagers have assigned populations to Category 2 based on current information, but ongoing investigations, monitoring and studies may identify remnant indigenous population, which if found, may cause the population to be reassigned to Category 1. Decisions by the TRT about roles of these populations in the ESU may also require the populations to be re-categorized and establish

natural-origin recruit objectives. This is one reason the RMP has ongoing monitoring and evaluation elements, and a reason why the 2003 RMP is a short term. The co-managers and NMFS recognize that there is ongoing work by the TRT and other resource managers that may affect future RMP.

Category 2 populations typically occur in watersheds where the habitat has been substantially degraded. In many of these systems, hatchery and natural fish are currently inseparable on the spawning grounds. In the future, on-going mass marking programs implemented at regional hatcheries will provide a means to distinguish between hatchery-origin and natural-origin adult chinook salmon on the spawning grounds. Given the conditions of these watersheds, the co-managers' goal of harvest management is to provide sufficient escapement to the spawning grounds to increase natural productivity. Future decisions regarding the form and timing of recovery efforts in these watersheds will dictate the kinds of harvest actions that may be necessary and appropriate.

Category 3: Category 3 watersheds are where populations are generally found in small tributaries that may now have some natural spawning, but never historically had independent, self-sustaining populations of chinook salmon. Several Category 3 watersheds were identified in the 2001 RMP (PSIT and WDFW 2001). However, the 2003 RMP does not identify or establish management objectives for any Category 3 watersheds. Consistent with the TRT guidance, these small tributary spawning aggregations characteristic of Category 3 watersheds do not meet the current definition of an independent population.

There are two main reasons why naturally spawning chinook salmon may not be designated as an independent population, First, spawning adults are known to occur intermittently in certain streams, spawning in the tens to hundreds in some years and none in other. A plausible biological explanation for intermittent occurrence of chinook salmon in some streams is that those adults are part of a larger independent population that uses the spawning habitat only during years of high abundance or favorable habitat conditions (NMFS 2001b). While these areas may not contain independent populations, the TRT may conclude that fish and habitat outside independent population boundaries may be important for the ESU's viability (NMFS 2001c). Second, it is possible that some streams currently containing chinook salmon never historically supported naturally spawning chinook salmon. The natural spawning chinook salmon present in these cases may be due to hatchery production (NMFS 2001b). As additional information is gained in some of these systems, one or more populations may be identified and assigned to Category 1 or Category 2 by the co-managers.

The 2003 RMP Nooksack, Skagit Summer/Fall, Skagit Spring, Stillaguamish, Snohomish, and Lake Washington Management Units include multiple populations[5]. The co-managers aggregated populations in the case of these management units for several reasons: (1) information is currently insufficient to derive population-specific objectives; (2) there is no information suggesting the populations are exploited unequally in mixed-population fisheries or no populations have discrete extreme terminal areas where they could be harvested independently; (3) the populations have similar migration timing, catch distribution or

[5] The Mid-Hood Canal Management Unit contains one TRT recognized population, but three populations as identified in the 2003 RMP.

productivity such that harvest objectives should also be similar; and (4) objectives have been derived for each population in the aggregate and the management unit as a whole is managed to achieve them.

(2) Section (b)(4)(i)(B) Uses the concepts of ''viable'' and ''critical'' salmonid population thresholds, consistent with Viable Salmonid Populations (VSP) concepts in "Viable Salmonid Population" (NMFS 2000b)

The regulations in the 4(d) Rule state that the RMP must use the concepts of "viable" and "critical" thresholds in a manner so that fishery management actions; (1) recognize significant differences in risk associated with viable and critical population threshold states, and (2) respond accordingly to minimize long-term risks to population persistence. Given considerations of actions in the other "Hs" (Habitat, Hatchery, and Hydropower), harvest actions that impact populations that are currently at or above their viable thresholds must maintain the population or management unit at or above that level. Fishing-related mortality on populations above critical levels but not at viable levels (as demonstrated with a high degree of confidence) must not appreciably slow rebuilding to viable function. Fishing-related mortality to populations functioning at or below their critical thresholds must not appreciably increase genetic and demographic risks facing the population and must be designed to permit achievement of viable functions, unless the RMP demonstrates the likelihood of survival and recovery of the entire ESU in the wild would not be appreciably reduced by greater risks to an individual population.

The harvest regime specified by the co-managers takes into account the different risks facing a population depending on the status of the population: above the interim escapement goal; below the interim escapement goal but above the critical abundance; or below the critical abundance. The 2003 RMP's "objective for annual, pre-season fishery planning is to develop fishing regimes that will exert exploitation rates that do not exceed the objectives [such as the 2003 RMP's recovery exploitation rate] for each management unit" (page 4 of the 2003 RMP). The 2003 RMP's management strategy is to keep exploitation rates at or below a management unit-specific recovery exploitation rate ceiling rate, as long as the unit's spawning escapement is expected to be above the critical abundance threshold. If the population falls below the critical abundance threshold, the co-managers would then impose the minimum fisheries regime exploitation rate ceiling (page 24 of the 2003 RMP), and may take additional actions as necessary. Where commingled hatchery-origin stocks predominate, fisheries are managed for the weakest natural population.

Several of the 2003 RMP's recovery exploitation rate ceilings are designed to be risk averse by providing a high probability of survival and recovery to the listed salmon. Where sufficient information is available, the co-managers show that harvest at these recovery exploitation rate ceilings would still provide a "high probability (at least 80%) of the spawning escapement increasing in 25 years to a specified [viable] threshold" *or* the "percentage of escapements less than this threshold level at the end of 25 years differs from a zero harvest regime by less than 10 percentage points" (page 21 of the 2003 RMP).

The co-managers have developed exploitation rates of this type for a subset of the management units (Skagit Summer/Fall, Skagit Spring, Stillaguamish, and Snohomish Management Units),

and plan on developing exploitation rates of this type for the remaining management units over the next several years, or as data become available. In the interim, for those management units where productivity analysis has not been completed, or data are not available, the 2003 RMP's recovery exploitation rates, they believe, are designed to stabilize, and where possible, increase escapements.

The 2003 RMP's management objectives (recovery exploitation rate ceilings, interim escapement goals, critical abundance thresholds, and the minimum fishery regime exploitation rates) established for the Category 1 and 2 populations captures the full range of genetic diversity and life history traits exhibited by chinook salmon populations within the Puget Sound chinook salmon ESU.

NMFS has also completed a comprehensive analysis for a subset of Puget Sound chinook salmon populations and derived viable and critical population thresholds for those populations (Table 5). NMFS' derived thresholds will be used to evaluate the risks associated with the 2003 RMP for these populations. The method used by NMFS to develop these thresholds are discussed in more detail in the following section, Section (b)(4)(i)(C), starting on page 32. Section (b)(4)(i)(C) describes the setting of the maximum exploitation rates, which NMFS' derived thresholds are an integral component of the methods used. For populations without NMFS' derived critical and viable population thresholds, generic guidance from the VSP paper will be used to evaluate the 2003 RMP's thresholds. The VSP guidance suggests that effective population sizes of less than 500 to 5,000 per generation are at increased risk (NMFS 2000b). The population size range per generation can be converted to an annual spawner abundance range of 125 to 1,250 by dividing by four, which is the approximate generation length of Puget Sound chinook salmon.

The 2003 RMP's critical abundance threshold (lower) and interim escapement goal (upper) management objectives compared to the NMFS' derived critical (lower) and viable (upper) thresholds are depicted in Table 5. The recent 1997 to 2001 annual and the 1997 to 2001 average estimated escapement are also depicted in Table 5.

The 2003 RMP's lower and upper thresholds are very similar to those which were implemented by the co-managers during the past two years, under the 2001 RMP. It is difficult to generate trends in escapement for a two-year-old management plan. However, general observations of decreasing, stable, or increasing trends can be made on the escapement over a recent five-year period (1997 to 2001). The 2002 escapement results were unavailable at the time in the 2003 RMP was completed.

One of the criteria for Limit 6 of the 4(d) Rule is that harvest actions that impact populations at or above their viable thresholds must maintain the population or management unit at or above that level. Based on the 1997 to 2001 five-year average escapements, there are three populations which fall into this classification (Table 6). Of these populations, all have either stable or increasing five-year escapement trend over the five-year period reviewed (Table 6). The results in 2000 and 2001 appear to be maintaining these populations above the viable threshold levels.

Another criterion for Limit 6 of the 4(d) Rule is that fishing-related mortality on populations above critical levels, but not at viable levels (as demonstrated with a high degree of confidence),

must not appreciably slow achievement to viable function. There are 15 populations which fall within this classification (Table 6). Of these populations, all have either a stable or an increasing five-year escapement trend (Table 6). Overall, escapements observed under the 2001 RMP have been some of the highest during the five-year period reviewed.

The criterion for populations at or below their critical thresholds is that fishing-related mortality on the populations must not appreciably increase genetic and demographic risks facing the population and must be designed to permit achievement of viable functions, *unless the RMP demonstrates the likelihood of survival and recovery of the entire ESU in the wild would not be appreciably reduced by greater risks to an individual population*.

There are four populations that are below their critical threshold criteria: the North Fork Nooksack River, South Fork Nooksack River, Dosewallips River, and the Dungeness River populations (Table 6). These populations are at extremely low levels of abundance (Table 5). Three populations (North Fork Nooksack River, South Fork Nooksack River, and the Dungeness River) have shown an increasing five-year escapement trend (Table 6). Escapements observed in these three systems, under the 2001 RMP, have been some of the highest observed during the five-year period reviewed.

The estimated escapement into the Dosewallips River has not exceeded 58 fish during a recent four-year period reviewed[6], and ranged from 29 to 58 fish. The most recent escapement results have been below the four-year average escapement into the Dosewallips River of 47, suggesting a declining population status. The co-managers intend to evaluate the impacts of the 2003 RMP to see whether this trend continues. The co-managers' goal for the Mid-Hood Canal Management Unit is "to maintain and restore sustainable, locally adapted, natural-origin chinook sub-populations. Management efforts will initially focus on increasing the abundance in the MU [management unit] and its local, natural sub-populations" (see page 165 of the 2003 RMP).

The co-managers will provide mortality information as well as information on escapement for all populations identified in the 2003 RMP so that the co-managers can continue to evaluate the population trends and adjust future fishery management plans as needed.

More specific analysis of the upper and lower thresholds in relationship to the risk of the populations under the 2003 RMP follows.

[6] The escapement for 1997 was not provided in the 2003 RMP, preventing a five-year (1997 to 2001) evaluation.

Table 5. The 2003 RMP's critical abundance threshold (lower) and interim escapement goal (upper) management objectives compared to the NMFS' derived critical threshold (lower) and viable threshold (upper). Recent 1997 to 2001 annual and 1997 to 2001 average estimated escapements are also depicted.

Management Unit	Population	1997	1998	1999	2000	2001	1997 - 2001 Average	2003 RMP Thresholds Lower [1]	2003 RMP Thresholds Upper [2]	NMFS' Derived Thresholds Lower [3]	NMFS' Derived Thresholds Upper [4]
Nooksack [5, 6]		223	128	255	442	517	313	-	*4,000*	-	-
	North Fork Nooksack	121	39	91	159	250	132	*1,000*	-	*200*	*1,250*
	South Fork Nooksack	102	89	164	283	267	181	*1,000*	-	*200*	*1,250*
Skagit Summer/Fall		4,872	14,609	4,924	16,930	13,793	11,026	*4,800*	*14,900*	-	-
	Upper Skagit River	4,168	11,761	3,586	13,092	10,084	8,538	*2,200*	-	*967*	*7,454*
	Lower Sauk River	295	460	295	576	1,103	546	*400*	-	*200*	*681*
	Lower Skagit River	409	2,388	1,043	3,262	2,606	1,942	*900*	-	*251*	*2,182*
Skagit Spring		1,041	1,086	471	906	1,856	1,072	*576*	*3,000*		
	Upper Sauk River	305	290	180	273	543	318	-	-		
	Suiattle River	428	473	208	360	688	432	-	-		
	Upper Cascade River	308	323	83	273	625	322	-	-		
Stillaguamish [5, 6]		839	863	767	1,127	936	907	*650*	*2,000*	--	-
	N.F. Stillaguamish River	613	615	514	884	653	656	*500*	-	*300*	*552*
	S.F. Stillaguamish River	226	248	253	243	283	251	-	-	*200*	*300*
Snohomish [5]		3,517	2,919	2,430	2,900	5,869	3,527	*2,800*	*5,250*	-	-
	Skykomish River	1,696	1,500	1,382	1,773	3,052	1,881	*1,745*	-	*1,650*	*3,500*
	Snoqualmie River	1,821	1,419	1,048	1,127	2,817	1,646	*521*	-	*300*	-
Lake Washington [5]		294	697	778	348	1,268	677	-	*1,550*		
	Cedar River	227	432	241	120	810	366	*200*	*1,200*		
	North Lake Wash. Trib.	-	-	-	-	-	-	-	-		
	Bear Creek (Index)	67	265	537	228	458	311	-	*350*		
Green River	Green River	9,967	7,300	9,100	6,170	7,975	6,788	*1,800*	*5,800*	*835*	*5,523*
White River	White River	400	316	553	1,523	2,002	959	*200*	*1,000*		
	Puyallup River	-	-	-	-	-	-	*500*	-		
Puyallup [7]	S. Prairie Cr. (Index)	-	-	-	-	-	-	-	*500*		
Nisqually	Nisqually River	340	834	1,399	1,253	1,079	981	-	*1,100*		
Skokomish	Skokomish River	2,337	6,761	9,919	4,959	10,529	6,901	*1,300*	*3,650*		
	Natural	452	1,177	1,692	926	1,913	1,232	*800*	*1,650*		
	Hatchery	1,885	5,584	8,227	4,033	8,616	5,669	*500*	*2,000*		

Mid-Hood Canal [8]		-	287	762	438	322	452	*400*	*750*		
	Hamma Hamma River	-	172	557	381	248	339	-	-		
	Duckabush River	-	57	151	28	29	66	-	-		
	Dosewallips River	-	58	54	29	45	47	-	-		
Dungeness	Dungeness River	50	110	75	218	453	181	*500*	*925*		
Elwha	Elwha River	2,517	2,358	1,602	1,851	2,208	2,107	*1,000*	*2,900*		
ESU Total		26,397	38,268	33,035	39,065	48,807	36,939 [9]				

1 2003 RMP's critical abundance thresholds.
2 2003 RMP's interim escapement goals.
3 NMFS' derived critical threshold.
4 NMFS' derived viable threshold.
5 All escapement and the 2003 RMP's thresholds represent natural-origin spawners. Escapement numbers are as reported in the 2003 RMP except for the Nooksack and Stillaguamish Management Units.
6 The Nooksack and Stillaguamish Management Units' escapements are as reported in the TRT's abundance and productivity data tables. The natural-origin escapement information needed to establish the natural-origin population's status was not available for all populations or years in the 2003 RMP.
7 Annual estimates of spawning escapement were not provided. The 2003 RMP does state that between "1994 and 2001, escapement to the South Prairie Creek sub-basin [index area] has ranged from 667 to 1430 fish, averaging 1048" (page 150 of the 2003 RMP).
8 The 2003 RMP's populations within this management unit include the Hamma Hamma, Duckabush, and the Dosewallips Rivers. The TRT currently only recognizes one population, the Dosewallips River.
9 Includes the 1994 to 2001 average escapement of 1,048 into South Prairie Creek index area.

Table 6. Puget Sound chinook salmon populations that have generally been above the upper threshold, populations that have generally been below the upper threshold but above the lower threshold, and populations that have generally been below the lower threshold, based on 1997 to 2001 annual and average estimated escapements.

Classification	Management Unit	Population	Five-Year Status [2]
Populations that have been above the upper thresholds:	Skagit Summer/Fall	Upper Skagit River	Increasing
	Stillaguamish	N.F. Stillaguamish River	Stable
	Green River	Green River	Stable
Populations that have been above the lower threshold but below the upper threshold:	Skagit Summer/Fall	Lower Sauk River	Increasing
		Lower Skagit River	Increasing
	Skagit Spring	Upper Sauk River [1]	Stable
		Suiattle River [1]	Stable
		Upper Cascade River [1]	Stable
	Stillaguamish	S.F. Stillaguamish River	Stable
	Snohomish	Skykomish River	Stable
		Snoqualmie River	Stable
	Lake Washington	Cedar River	Stable
		North Lake Wash. Trib.[1]	Stable
	White River	White River	Increasing
	Puyallup	Puyallup River	- [3]
	Nisqually	Nisqually River [1]	Increasing
	Skokomish	Skokomish River	Stable (Natural)
	Elwha	Elwha River	Stable
Populations that have been below the lower threshold:	Nooksack	N. F. Nooksack River	Increasing (NOR[4])
		S. F. Nooksack River	Increasing (NOR[4])
	Mid-Hood Canal	Dosewallips River [1]	Declining
	Dungeness	Dungeness River	Increasing

1 The 2003 RMP populations do not have an upper and/or a low threshold established. The VSP (NMFS 2000b) guidance or the management unit's other established thresholds assisted in the classification of these populations.

2 The status of a population was considered increasing if the 2000 and 2001 escapements were both above the recent five-year average. Population status was considered declining if the 2000 and 2001 escapements were both below the recent five-year average. Population status was considered stable if one of the 2000 or 2001 escapement was above the recent five-year average and one of the 2000 or 2001 escapement was below the recent five-year average.

3 Information was not available in the 2003 RMP to determine status. However, the 2003 RMP does state that between "1994 and 2001, escapement to the South Prairie Creek sub-basin [Index Area] has ranged from 667 to 1430 fish, averaging 1048" (page 150 of the 2003 RMP). The 2003 RMP's upper threshold for this population is for an escapement of 500 into this index area.

4 Natural-origin recruits.

NMFS' VSP document (NMFS 2000b) describes four key parameters for evaluating the status of salmonid populations. These parameters are: (1) population size (abundance); (2) population growth rate (productivity); (3) spatial structure; and (4) diversity. Below is an evaluation of how the RMP addresses these four VSP parameters for the Puget Sound chinook salmon ESU.

(1) Population Size

Lower Thresholds:

With the exception of the Nisqually Management Unit[7], the 2003 RMP establishes critical abundance thresholds for all populations or management units (see Table 5). The co-managers cite the lack of data as preventing them from establishing critical abundance thresholds for individual populations in some management units (Skagit Spring, Stillaguamish, Lake Washington, and the Mid-Hood Canal Management Units).

The 2003 RMP's critical abundance thresholds are the same, or in the case of the Stillaguamish and Snohomish Management Units, slightly greater then the critical abundance thresholds in the 2001 RMP. Methods used by the co-managers to establish the critical abundance thresholds in the 2003 RMP include: (1) the lowest escapement with a greater than one return per spawner ratio; (2) the forecasted escapement for which there is a five percent probability that the observed escapement will be below the point of instability; and (3) generic VSP guidelines (NMFS 2000b). The method chosen by the co-managers depended on the quality and quantity of population-specific data available (see Appendix A: Management Unit Status Profile of the 2003 RMP).

NMFS' derived critical thresholds ranged from 200 to 1,650 (see Table 5). For those populations for which the 2003 RMP identifies a critical abundance threshold, the 2003 RMP's thresholds are consistent with NMFS' critical thresholds. However, in the Stillaguamish Management Unit, where NMFS has derived a critical threshold for both populations, the 2003 RMP did not establish a critical abundance threshold for the South Fork Stillaguamish River population. The following addresses this lack of a critical threshold for the South Fork Stillaguamish River population in the 2003 RMP.

Stillaguamish Management Unit - The Stillaguamish Management Unit includes two populations: the North Fork Stillaguamish River and the South Fork Stillaguamish River. The 2003 RMP establishes two critical abundance thresholds for this management unit, which is based on natural-origin spawners. Both populations are classified as Category 1 populations (see Table 4). The lower threshold for the North Fork Stillaguamish River population is 500 and the lower threshold for the entire Stillaguamish Management Unit is 650 (see Table 5). The 2003 RMP provides no critical abundance threshold for the South Fork Stillaguamish River population, citing that further analysis is needed (page 112 of the 2003 RMP).

Recent escapement observations for these systems were used to estimate the South Fork Stillaguamish River population escapement when the population nears the management unit's

[7] The Nisqually Management Unit is managed as a terminal fishery for an escapement goal of 1,100 natural spawning chinook salmon (see page 156 of the 2003 RMP).

critical abundance threshold of 650. On average, escapement into the South Fork Stillaguamish River was 27.7 percent of the total natural-origin escapement in the Stillaguamish River, for the years 1997 to 2001 (Table 7). At natural-origin escapements approaching the management unit's 2003 RMP critical abundance threshold of 650 natural-origin fish, assuming similar proportions to recent escapement observations, the natural-origin escapement into to the South Fork Stillaguamish River population would be 180 (27.7% of 650).

Table 7. Recent five-year average natural-origin escapement for the two individual populations within the Stillaguamish Management Unit.

Population:	1997 to 2001 Escapement		
	Range	Average	Percent
N. F. Stillaguamish River	514 to 884	656	72.3%
S. F. Stillaguamish River	226 to 283	251	27.7%
Total		907	100%

An escapement of 180 would be below the NMFS' derived critical threshold of 200 for this population, suggesting possible elevated level of risk for South Fork Stillaguamish River population under the 2003 RMP at levels approaching the 2003 RMP's critical abundance level.

Actual impacts to the South Fork Stillaguamish River population under the one-year 2003 RMP will depend on the returning abundance in 2003, whether it is above the interim escapement goal, below the interim escapement goal but above the critical abundance threshold, or below the critical abundance threshold. The preliminary 2003 forecast[8] of the adult return to Stillaguamish River is projected to be 2,050 (NMFS 2003), well above the management unit's critical abundance threshold of 650. Based on the proportions of the recent observed escapement, the proportion of the 2003 forecast bound for the South Fork Stillaguamish River would be 568 (27.7% of 2,050). The anticipated 2003 total exploitation rate on the Stillaguamish River Management Unit is 18 percent (based on the preliminary pre-season FRAM model run 1603). The anticipated natural-origin escapement into the South Fork Stillaguamish River in 2003 is 466 (568 - (568 x .18)), which is above the NMFS' derived critical abundance of 200. The 2003 return of natural chinook salmon to the Stillaguamish River is very similar to the pre-season forecast in 2002 of 2,002, and above the pre-season forecast for 2001 of 1,400 (WDFW 2003b).

The 2003 RMP's recovery exploitation rate ceiling for this management unit is 25 percent, representing a substantial decrease from exploitation rates affecting the management unit throughout the 1980s and into the 1990s (see page 110 of the 2003 RMP). Escapement into the South Fork Stillaguamish River has remained stable between 200 and 300 in recent years; consistently above the NMFS' derived critical threshold for this population of 200, but still below the NMFS' derived upper (viable) threshold of 300 (see Table 5). The population is considered stable (see Table 6).

Based on the preliminary 2003 forecast return information, past performance of the fishery under similar conditions, the current status of the population, it is expected that the returning

[8] Expected escapement without fishing.

population will be above the co-managers' critical abundance threshold for the Stillaguamish Management Unit during the implementation of the 2003 RMP. There should be no elevated level of risk in 2003 due to the lack of a critical abundance threshold in the 2003 RMP for the South Fork Stillaguamish River population.

For those populations or management units which can not be compared to any NMFS' derived critical thresholds, all 2003 RMP's critical abundance thresholds exceed the minimum VSP guidance of 125 annual spawners. However, two of the 2003 RMP's critical abundance thresholds are for a management unit, which have multiple populations (e.g., Skagit Spring and the Mid-Hood Canal[9] Management Units), and no critical abundance threshold is provided for the north Lake Washington tributaries population or for the management unit it is within (see Table 5). The following addresses these three management units (Skagit Spring, Mid-Hood Canal, and Lake Washington Management Units).

Skagit Spring Management Unit - Skagit Spring Management Unit has a 2003 RMP's critical abundance threshold of 576. However, the management unit has three populations: the upper Sauk, the Suiattle, and the upper Cascade Rivers. All populations are classified as Category 1 populations (see Table 4). No individual critical abundance thresholds were proposed by the 2003 RMP for these three populations. Recent escapement observations for these systems were used to estimate the escapement to the individual populations when the return approaches the management unit's critical abundance threshold of 576.

Table 8 provides the recent five-year average escapement for the three populations within the Skagit Spring Management Unit. At escapement levels approaching the management unit's critical abundance threshold of 576, assuming similar proportions to recent observations, escapements in the upper Sauk, the Suiattle, and the upper Cascade Rivers would be 173 (30% of 576), 230 (40% of 576), and 173 (30% of 576), respectively. Escapement at these levels would all be within the spawner abundance range guidance provided by the VSP paper of 125 to 1,250 fish, although at the lower end of this range.

Table 8. Recent five-year average escapement for the three individual populations within the Skagit Spring Management Unit.

Population:	1997 to 2001 Escapement		
	Range	Average	Percent
Upper Sauk River	108 to 543	318	30%
Suiattle River	208 to 688	432	40%
Upper Cascade River	83 to 625	322	30%
Total		1,072	100%

The 2003 preliminary forecast for the natural adult return of spring adult chinook salmon to the Skagit River is 1,150 (NMFS 2003), above the 2001 and 2002 pre-season forecasts of 890 and 885, respectively (WDFW 2003b). During the recent five-year average, the total Skagit Spring Management Unit's escapement has been more than 1,000, well above the management unit's

[9] The Mid-Hood Canal Management Unit contains one TRT recognized population, but contains three populations as identified in the 2003 RMP.

critical abundance threshold of 576 (see Table 5). The highest escapement observed during the five-year period reviewed of 1,856, occurred in 2001 under the 2001 RMP.

Based on the available 2003 return information, past performance of the fishery under similar conditions, the current status of the population, it is expected that the individual populations within the Skagit Spring Management Unit will be within the VSP guidance during the 2003 RMP implementation. There should be no elevated level of risk for the populations within the Skagit Spring Management Unit in 2003 due to the lack of individual critical abundance thresholds in the 2003 RMP.

Mid-Hood Canal Management Unit - The 2003 RMP proposes three populations, the Hamma Hamma, the Duckabush, and the Dosewallips Rivers. The 2003 RMP considers all three mid-Hood Canal systems (Hamma Hamma, Duckabush, and the Dosewallips Rivers) in the management of the Mid-Hood Canal Management Unit. The 2003 RMP provides a critical abundance threshold for the entire management unit only, combining escapement from all three systems. If these three systems were considered components of one population, the 2003 RMP's critical abundance threshold of 400 would be above the minimum VSP guidance. However, NMFS evaluated the potential impacts of the 2003 RMP on the populations, as preliminarily recognized by the TRT as of January 8, 2003. For the Mid-Hood Canal Management Unit, the TRT preliminarily recognized only one population within this management unit, the Dosewallips River. The Dosewallips River population is considered by the co-managers as a Category 2 population (see Table 4) and is classified as being below its critical threshold (see Table 6).

The role of the undefined spawning aggregations in the adjacent Hamma Hamma and the Duckabush Rivers in recovery and their relationship with the Dosewallips River population may be clarified as further information becomes available. Because it is possible that production in the Hamma Hamma and the Duckabush Rivers may contribute to the stability of the Dosewallips River population, NMFS' assessment of the impacts of the 2003 RMP on the Dosewallips should be considered conservative.

Table 9 provides the recent four-year average escapement for the three systems within the Mid-Hood Canal Management Unit[10]. Assuming similar proportions to recent observations, at population levels approaching the management unit's critical threshold of 400, the escapement into the Dosewallips River would be 40 (10% of 400). Projected escapement into the Hamma Hamma and the Duckabush Rivers would be 300 (75% of 400) and 60 (15% of 400), respectively. An escapement of 40 into the Dosewallips River would be well below the spawner abundance range guidance for a population provided by the VSP paper of 125 to 1,250.

[10] The escapement for 1997 was not provided in the 2003 RMP, preventing a five-year (1997 to 2001) evaluation. The reported Dosewallips and Duckabush River escapements are considered minimal. The 2003 RMP states that in "the Dosewallips and Duckabush, however, the areas surveyed are transit areas and do not include all spawning areas. Upper reaches of the Dosewallips and Duckabush have been more routinely surveyed since 1998, but few chinook adult or redds have been observed" (page 163 of the 2003 RMP).

Table 9. Recent four-year average escapement for the three individual populations within the Mid-Hood Canal Management Unit.

Population:	1998 to 2001 Escapement		
	Range	Average	Percent
Hamma Hamma River	172 to 557	339	75%
Duckabush River	28 to 151	66	15%
Dosewallips River	29 to 58	47	10%
Total		452	100%

The preliminary 2003 forecast return to the Washington Catch Area 12B, the mid-Hood Canal region, of 550 (NMFS 2003) is greater then the pre-season forecasts for the past two years of 360 in 2001 and 478 in 2002 (WDFW 2003b). Although the total adult return in 2003 to the Mid-Hood Canal Management Unit may be above the 2003 RMP's critical abundance threshold of 400, based on recent escapement proportions, the Dosewallips River proportion of the forecast would be only 55 (10% of 550). The anticipated 2003 total exploitation rate on the Mid-Hood Canal Management Unit is 29 percent (based on the preliminary pre-season FRAM model run 1603). The anticipated escapement into the Dosewallips River in 2003 is 39 (55 - (55 x .29)), which is well below the VSP spawner abundance guidance.

Based on the preliminary 2003 forecast, past performance of the fishery under similar conditions, and current status of the population, it is expected that the 2003 return into the Dosewallips River will continue to be below the VSP spawner abundance range guidance for a population. The escapement trend in the Dosewallips River has been declining over the four-year period reviewed (see Table 5). Additional risk to the Dosewallips River population within the Mid-Hood Canal Management Unit may be expected in 2003, in part, due to the lack of an individual critical abundance threshold for the Dosewallips River population, to provide management guidance.

Lake Washington Management Unit - The Lake Washington Management Unit contains two populations; the Cedar River (Category 1) and the north Lake Washington tributaries (Category 2) populations. The 2003 RMP's critical abundance threshold for the Cedar River population is 200 chinook salmon. There are no critical abundance thresholds in the 2003 RMP for the north Lake Washington tributaries population or for the management unit as an aggregate of the two populations.

Table 10 provides the recent five-year average escapement for the two populations within the Lake Washington Management Unit. At populations approaching the 2003 RMP's critical abundance threshold of 200 for the Cedar River, assuming similar proportions to recent escapement observations, the corresponding escapement into the northern Lake Washington tributaries, the Bear Creek index area, would be 170 ((200 x 46)/54). However, Bear Creek is only an index of the northern Lake Washington tributaries population. The actual escapement into the northern Lake Washington tributaries would be even greater. Escapement at this level would be above the spawner abundance range guidance for a population provided by the VSP paper of 125 to 1,250,

Table 10. Recent five-year average escapement for the two individual populations within the Lake Washington Management Unit.

Population:	1997 to 2001 Escapement		
	Range	Average	Percent
Cedar River	120 to 810	366	54%
N. Lake Wash. Trib. Bear Creek (Index)	67 to 537	311	46%
Total		677	100%

Actual implications to the northern Lake Washington tributaries population under 2003 RMP would depend, in part on the returning abundance in 2003, whether it is above the interim escapement goal, below the interim escapement goal but above the critical abundance threshold, or below the critical abundance threshold. The combined preliminary 2003 forecast return to the Cedar River and the north Lake Washington tributaries of 700 (NMFS 2003) is below the combined pre-season forecast return of 1,675 in 2002, but above the pre-season forecast return of 290 in 2001 (WDFW 2003b).

Recent escapement into the northern Lake Washington tributaries have ranged from 25 to 458, with a recent five-year average of 311 (see Table 5), above the lower end of the spawner abundance range guidance for a population provided by the VSP paper of 125. The escapement trend in the north Lake Washington tributaries has been stable over the recent five-year period reviewed, although the escapement in 2001 was the highest observed in the five-year period (see Table 5). The population status is considered stable (see Table 6). The escapement results in 2001 were under the 2001 RMP, which is very similar to the 2003 RMP.

Based on the preliminary 2003 return information, past performance of the fisheries under similar conditions, the current status of the population, it is expected that the northern Lake Washington tributaries population within the Lake Washington Management Unit will be within the VSP guidance during the 2003 RMP implementation. There should be no elevated level of risk for the northern Lake Washington tributaries population within the Lake Washington Management Unit in 2003 due to the lack of an individual critical abundance threshold for the northern Lake Washington tributaries population in the 2003 RMP.

In summary of the lower thresholds analysis, additional risk to the Dosewallips River population within the Mid-Hood Canal Management Unit may be expected in 2003, in part, due to the lack of an individual critical abundance threshold for the Dosewallips River population, to provide additional management guidance.

Upper Thresholds:

The 2003 RMP has viable thresholds (interim escapement goals) for all populations or management units (see Table 2). The technical bases for these interim escapement goals varies among management units (see footnotes to Table 14, page 57 of the 2003 RMP). In some cases they are an historical average, derived during a relatively high abundance period. The 2003 RMP's interim escapement goals are the same, or in the case the Elwha Management Unit, even greater then the viable thresholds in the 2001 RMP.

NMFS' derived viable thresholds ranged from 300 to 7,454 (see Table 5). All NMFS' derived viable thresholds were for individual populations. The 2003 RMP interim escapement goals were applied to the entire management unit and not to the individual populations within that management unit. Direct comparisons between NMFS' derived viable thresholds and the management unit's interim escapement goal were made more difficult in cases where there were multiple populations within the management unit. However, when the combined individual NMFS' derived viable thresholds for populations within a given management unit is compared to the 2003 RMP's interim escapement goal for that management unit, the 2003 RMP's interim escapement goals met or exceeded all NMFS' derived upper (viable) thresholds.

Productivity:

The co-managers define productivity as the measurement of the survival rate of the population from one life stage to another (page 69 of the 2003 RMP). Productivity is primarily driven by habitat quality and reproductive fitness. One aspect of habitat quality is the level of marine-derived nutrients introduced into an ecosystem by eggs deposited by spawning salmon and by decaying salmon carcasses. The RMP addresses the role of adult salmon in nutrient re-cycling in Appendix D: Role of Adult Salmon in Nutrient Re-cycling. Marine-derived nutrients are a source of food for juvenile salmonids, invertebrates, and provide basic nutrients to the ecosystems (Larkin and Slaney 1996; Gresh *et al.* 2000; Murota 2002; Wipfli *et al.* 1998). However, nutrient dynamics in aquatic systems is very complex (Polis *et al.* 1997; Bisson and Bilby 1998; Murphy 1998; Naiman *et al*. 2000). The importance of salmon nutrient re-cycling within a given aquatic ecosystem remains very poorly understood and is dependent on numerous site-specific factors. These factors include: the species of salmon; spawning density; spawning location; stream discharge regimes in the area; stream habitat complexity; basin geology; light; temperature; and ecosystem community structure.

The role of returning adult chinook salmon as a means of re-cycling nutrients into a freshwater ecosystem must be examined in the context of the limitations of current research on the subject, chinook salmon life history, and chinook salmon abundance relative to the generally more abundant escapement of other salmon (coho - *Oncorhynchus kisutch*, pink -*O. gorbuscha* , and chum - *O. keta* salmon) in the larger river systems that typically support the Puget Sound chinook salmon populations. Additionally, while the limited available research suggests that salmon-derived nutrients can benefit coho salmon, sockeye salmon (*O. nerka*), and cutthroat trout (*O. clarki*) populations, data and technical tools establishing or quantifying the relationship between marine-derived nutrients and chinook salmon are not available.

Chinook salmon populations in Puget Sound typically exhibit a relatively short freshwater residence, at least when compared with coho salmon, sockeye salmon, and steelhead. It is not known if newly emerged chinook salmon fry actively feed on chinook salmon carcasses, or if chinook salmon carcasses are retained for a sufficient period in the freshwater ecosystem to allow direct consumption by emerging fry, especially in the larger river systems which support chinook salmon. The larger river systems in the action area generally exhibit peak winter flow events which may flush the chinook salmon carcasses from the freshwater ecosystem.

The benefits of marine derived nutrients for juvenile chinook salmon may be more fully realized in estuaries (Simenstad 1997), where most chinook rear for a critical period prior to migrating seaward. However, even less is known about the role of marine-derived nutrients in estuaries. Consequently, it has not been demonstrated that carcass nutrient limitation, as it may affect secondary production of prey species or direct enhancement of food supply, currently exerts a key limit on the productivity of chinook salmon in Puget Sound Action Area.

Harvest management objectives must be appropriate for the habitat capacity and productivity requirements of individual populations. The 2003 RMP provides no explicit management objectives for productivity. The exploitation rates, escapement goals, and critical abundance thresholds are based where possible on current survival and productivity rates, with adjustments to account for data uncertainty and management imprecision.

The co-managers will be conducting ongoing monitoring and evaluation of the 2003 RMP. Based on information they obtain and that may be provided by other resource managers, the co-managers may revise the management objective in future plans, reflecting changes in environmental conditions and scientific understanding of carcass nutrient limitation. The intent of the co-managers is to increase spawners in concert with the recovery of the system's productivity and capacity resulting from habitat restoration efforts, thereby annually providing sufficient escapement to enable the management unit to generate maximum surplus under progressively improving habitat conditions. In this way, harvest management will complement concurrent efforts to restore and protect habitat, improve hatchery management practices, and mitigate the impacts of hydroelectric operations. In addition, spawner recruit functions used to derive many of the 2003 RMP's objectives express the impacts of all the factors that influence productivity, including nutrient input. However, changes in productivity will be exceedingly difficult to attribute to changes in nutrient input.

Spatial Structure

A fishery could target a certain portion of the run, which may result in a decrease in the number of spawners destined to a particular spawning location or population through time. For example, the early portion of a run of salmon may be the fish that will spawn the furthest upstream. If a fishery harvests just the early portion of the total adult return, the percentage of the population spawning in the upper portion of the system may be changed.

In Puget Sound, the co-managers generally shape salmon fisheries to harvest throughout the run timing of the returning adults. However, when harvest must be reduced, fishing-related mortality on listed chinook salmon is reserved as incidental harvest in salmon fisheries directed at other species. In these situations, the salmon fishery may concentrate incidental fishing-related mortality on the extreme ends of the run timing of listed fish in order to protect the majority of the run while providing access to other salmon species. The timing and extent that this occurs varies for year to year. In mixed-population salmon fisheries, harvest generally occurs throughout the migration of the returning chinook salmon. In terminal areas where chinook salmon are caught incidentally in fisheries targeting other species, harvest probably affects 15 percent or less of the run on either end of the run timing. There is currently no information to indicate that these incidental impact salmon fisheries are having deleterious effects on certain

segments of the populations or to the ESU. For example, NMFS' status review (Myers *et al.* 1998) did not note any trends in size, weight, fecundity or other life history traits for Puget Sound chinook salmon that might be a result of fishing activities.

More than any other factor, the loss of historic habitat has contributed to the loss of the spatial integrity of chinook salmon populations. Puget Sound chinook salmon habitat has been degraded through a variety of causes (Bishop and Morgan 1996; PSSSRG 1997). Loss of large woody debris, urbanization, dikes, water withdrawals, hydro development, changes in flow conditions have all contributed to the loss and degradation of spawning, early incubation and winter rearing habitat for chinook salmon. For example, hydro-modification in the Skagit River drainage has resulted in a loss of 64 percent of its distributary sloughs and 45 percent of side channel sloughs. These habitat types are critical to the viability of chinook salmon populations in that watershed.

Diversity

It is possible that fisheries under the one-year RMP may affect the diversity of size, age and sex ratio of the salmon escapement in an individual population or the ESU. For example, reproductive success may be impacted if a fishery were selective for large fish. Numerous studies have documented the importance of large size in naturally spawning chinook salmon populations for mate choice and reproductive success (e.g., Baxter 1991; Berejikian *et al.* 2000; Healey 2001; Healey and Heard 1984; Silverstein and Hershberger 1992).

The RMP addresses the effects of selective fishing by the co-managers on the age and size of the population in Appendix F: Age- and Size-selective Effects of Fishing. Selective salmon fisheries generally fall into three categories: size-selective, stock-selective, or species selective. *Size-Selective Fisheries:* Size-selective fisheries catch fish within a certain size range at a greater rate than fish that are either smaller or larger. A long-term shift to younger aged spawners may result (1) *if* chinook salmon mated randomly, without regard to age, on spawning grounds, and (2) *if* age at maturity were independent of growth rate. However, other factors may mitigate any long-term shifts. These factors include: (1) larger and older male and possibly females chinook salmon generally have greater mating success than smaller and younger male chinook salmon; (2) fast-growing chinook salmon tend to mature at younger ages than slow-growing chinook salmon, but are likely to be selected *against* in size-selective ocean fisheries; and (3) size at age may have only a weak correlation with some inherent genetically inherited growth rate.

Hard (in press) used age-structured quantitative genetics models to assess the possible long-term genetic effects of size-selective fishing on chinook salmon populations. He concluded, at most, that effects depend critically on the harvest rate, harvest size threshold, the strength of stabilizing natural selection on size, and most likely the age structure and heritability of each trait as well. Hard (in press) also found that the capacity of size-selective fishing to reduce size depends on correlations between size, age and growth rate.

Although the potential consequences of size selective fishing have been recognized, the ability of fisheries managers to address the potential long-term consequences is limited. In part this is because much of the evidence for selective effects of fishing (e.g., change in the size or age composition of catch or spawners) is circumstantial, and is confounded by other factors such as

data quality and several ecological variables, including marine productivity, density-dependent growth and mate choice on the spawning grounds (Heath *et al.* 1999, Ricker 1972).

In addition, the magnitude of selective effects will vary depending on the intensity of selective-fishing on a particular salmon population, the period of time over which those effects are encountered and the biological characteristics of the population itself (Heath *et al.* 1994, Hard in press). Hard (in press) found that, in general, reducing the exploitation rate reduced the selection intensity, and that potential changes in life history traits under most of the scenarios he examined were modest at best. Exploitation rates below 40 to 50 percent generally resulted in no to low changes in the biological traits examined. Most recovery exploitation rates in the 2003 RMP are less then 40 percent (see Table 2).

Regarding the potential age-selectivity of gear types, Puget Sound salmon gillnet fisheries do not appear to be any more age-selective than gear types like purse seines, which use small mesh and are considered to be relatively non-selective (Table 11 and Figure 3). Additionally, there have been no trends in age structure in Puget Sound chinook salmon escapement over the past 20 years that might indicate fishery age selectivity (Figure 4). Age composition of the chinook salmon catch in Puget Sound fisheries and escapement has been relatively stable since 1980.

Table 11. Average age composition of the catch of Puget Sound chinook salmon by gillnet, seine, and all gear combined, 1980 to 2000.

Gear	Age-2	Age-3	Age-4	Age-5
Gillnet	3%	34%	59%	5%
Seine	7%	37%	54%	4%
All Gear Combined	3%	35%	56%	6%

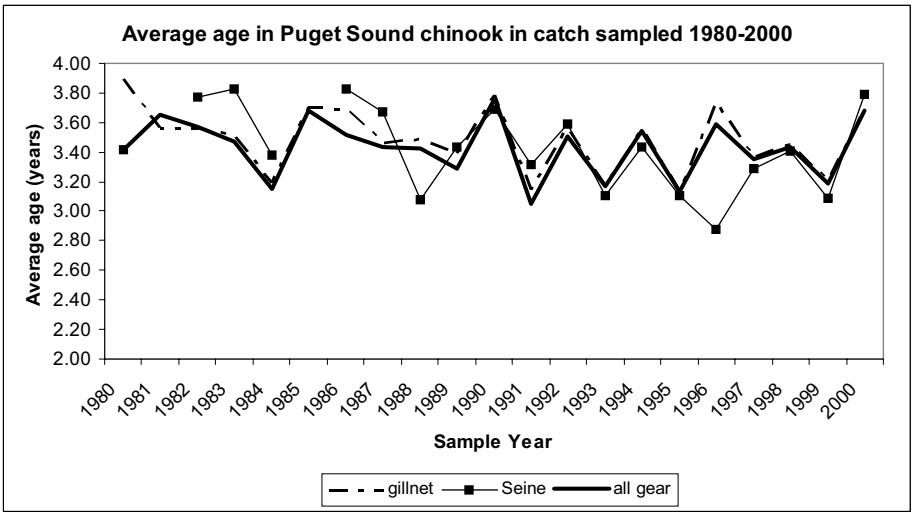

Figure 3. Age composition of Puget Sound chinook salmon catch in gillnets, seines, and for all gear combined has been relatively stable since 1980.

Stock-Selective Fisheries: Stock-selective fisheries harvest some populations at different rates than other populations. In marine waters, a large number of salmon populations originating from different river basins may be vulnerable to fishing at similar times and locations and may therefore experience similar marine exploitation rates. This is commonly referred to as the "mixed-stock harvest problem."

In Puget Sound, the co-managers manage salmon fisheries for stock-specific exploitation rates that depend on the underlying productivity of each population. In other words, fisheries are managed to protect the less abundant or less productive populations. Such an approach is commonly referred to as "weak stock management," and often results in foregoing catch on abundant populations in order to protect less abundant or less productive populations.

Species-selective Fisheries: Fisheries under the 2003 RMP may also be species-selective or population-selective. For example, a fishery is considered species-selective when all chinook salmon encountered must be released but all coho salmon may be retained. Fisheries may also target select populations in cases where either the targeted population or the population(s) to be released are marked externally, such as through an adipose fin clip. The co-managers have implemented both species-selective and population-selective salmon fisheries in the action area

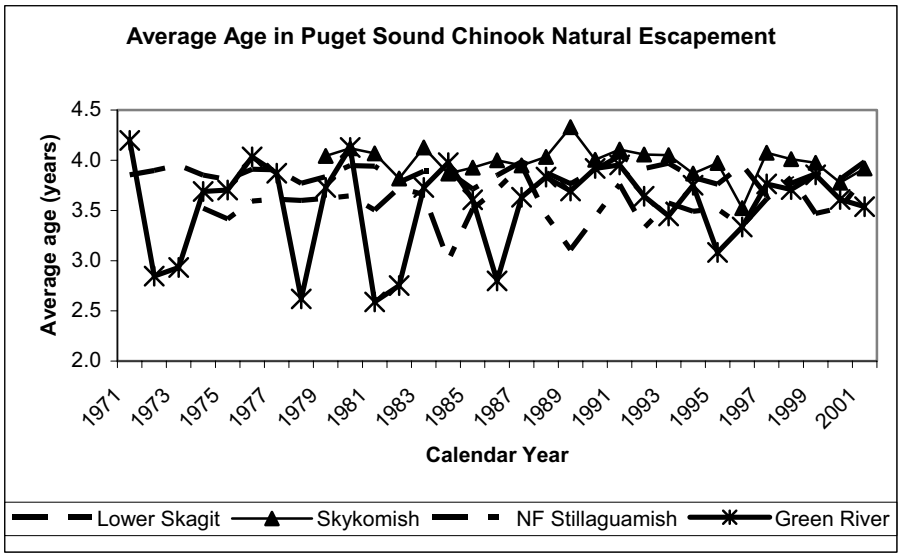

Figure 4. Age composition of Puget Sound chinook salmon escapement in select populations. The age compositions in these populations have been stable since the late 1980's.

Diversity parameters may also be influenced by habitat and hatcheries. Hatchery and Genetic Management Plans (HGMPs) are under development or review for all Puget Sound hatchery facilities potentially affecting listed chinook salmon (T. Tynan, NMFS. pers. com., to K. Schultz, NMFS, January 29, 2003).

(3) Section (b)(4)(i)(C) Sets escapement objectives or maximum exploitation rates for each management unit or population based on its status, and assures that those rates or objectives are not exceeded.

The 2003 RMP identifies recovery exploitation rate ceilings for all management units except the Nooksack and Nisqually Management Units[11] (see Table 2). Although the co-managers may manage fisheries for exploitation rates lower than the ceilings, the 2003 RMP's recovery exploitation rate ceilings may not be exceeded. Except for the Snohomish and White River Management Units, the 2003 RMP's recovery exploitation rate ceilings are the same as the recovery exploitation rate ceilings in the 2001 RMP. Both the Snohomish and White River Management Units 2003 RMP's recovery exploitation rates have been revised by the co-managers based on new information. The following briefly addresses the justification for the change in the RMP's recovery exploitation rate between the 2001 RMP and those being evaluated in the 2003 RMP for the Snohomish and White River Management Units.

Snohomish Management Unit - For the Snohomish Management Unit, the recovery exploitation rate ceiling was reduced from the 32 percent rate in the 2001 RMP to a 24 percent rate in the 2003 RMP. Analysis provided in the 2003 RMP, based on current conditions and simulations, indicated that lowering the recovery exploitation rate ceiling for the Snohomish Management Unit to 24 percent would make it unlikely that the populations within this management unit will fall below the 2003 RMP's critical abundance thresholds and likely increase to above the interim escapement (viable) goal (see page 118 through 133 of the 2003 RMP). This assessment provided by the co-managers is consistent with a separate analysis by NMFS to derive rebuilding exploitation rates for the populations within this management unit of 24 percent (NMFS 2000a).

White River Management Unit - In the case of the White River Management Unit, the fisheries simulation model was modified by the co-managers to incorporate only White River fingerling tag codes, which show a slightly different harvest distribution than yearlings that comprise the Pacific Salmon Commission Indicator Stock (page 147 of the 2003 RMP; WDFW and NWIFC 2003). The incorporation of only the White River fingerling tag codes is thought to be more representative of the naturally produced population. The changed 2003 RMP's recovery exploitation rate of 20 percent is slightly greater then the 17 percent recovery exploitation rate in the 2001 RMP.

Many of the 2003 RMP's recovery exploitation rates reflect the current productivity of the population (populations within the Skagit Summer/Fall, Skagit Spring, Stillaguamish, and the Snohomish Management Units). In these cases, simulation models were used by the co-managers to project escapements of the management unit or population over a 25-year period under a range of exploitation rates. The simulations included variability in data estimates, management error and survival conditions. In the long-term, the co-managers intend to develop recovery exploitation rates using this approach for other Puget Sound chinook salmon management units, as data becomes available.

[11] In 2003, the co-managers will manage the Nisqually Management Unit for an escapement goal of 1,100. The co-managers will manage the Nooksack Management Unit under the minimum fishery regime exploitation rate ceiling in 2003. The co-managers expect that the minimum fishery regime exploitation rate for the Nooksack Management Unit will be between five to nine percent for the SUS.

As discussed earlier, NMFS has also completed comprehensive analyses for a subset of Puget Sound chinook salmon populations and derived critical and viable thresholds for those populations. These thresholds were used by NMFS to calculate rebuilding exploitation rates (referred to as recovery exploitation rates in the 2001 ESA determination, NMFS 2001a) for these populations. It is useful to describe the process NMFS used in deriving the rebuilding exploitation rates. There are four steps involved with determining population specific rebuilding exploitation rates: (1) identify populations; (2) set threshold abundance levels; (3) estimate population productivity as indicated by a spawner-recruit relationship; and (4) identify through simulation the appropriate rebuilding exploitation rate. A brief discussion of these four steps follows. A more detail description of the process is available in a previous biological opinion (NMFS 1999).

(1) *Identify Population* - Section (b)(4)(i)(A) of this document (starting on page 10) discusses in more detail the Puget Sound chinook salmon population delineation as currently recognized by the TRT. The TRT reviewed several sources of information in deriving the preliminarily recognized delineations. These sources of information include geography, migration rates, genetic attributes, patterns of life history and phenotypic characteristics, population dynamics, environmental and habitat characteristics (NMFS 2001b). For populations within the ESU, as of January 8, 2003, the TRT has narrowed the earlier population delineation offered by the Salmon and Steelhead Stock Inventory and Assessment to 22 demographically independent populations representing the primary historical spawning areas of chinook salmon (see Table 3).

(2) *Threshold Abundance Levels* - The critical threshold was developed from a consideration of genetic, demographic, and spatial risk factors for each population. Genetic risks to small populations include the loss of genetic variation, inbreeding depression, and the accumulation of deleterious mutations. The risk posed to a population by genetic factors is often expressed relative to the effective population size, or the size of an idealized population that would produce the same level of inbreeding or genetic drift that is seen in an observed population. Factors associated with demographic risks include environmental variability and depensation. Depensation, or a decline in the productivity of a population (e.g., smolts per spawner) as the abundance declines, can result from the uncertainty of finding a mate in a sparse population and/or increased predation rates at low abundance.

Demographic risks were assessed using both the Dennis model (Dennis *et al*. 1991 as cited in NMFS 1999) and a Ricker stock-recruit model. The Dennis model can be used to provide an estimate of the number of spawners required to have a desired level of probability that the population does not go extinct within a defined period of time. For this analysis, NMFS estimated the population size that would be required to have a 95 percent probability that the population would not go extinct within 10 years. Critical threshold was also derived from an analysis of the Ricker stock-recruit relation. Peterman (1977, 1987) provided a rationale for depensation and suggested relating the escapement level at which depensation occurs to the size of the population in the absence of fishing (equilibrium escapement level). NMFS set this measure of the critical threshold equal to five percent of the equilibrium escapement level. Both these measures of the critical threshold were considered in the context of the types and quality of data available, the characteristics of the watershed, and the biology of the population. A similar

method was used to establish the viable population. A viable population was considered the level of escapement required to achieve the maximum sustainable yield (demographics). The larger of the two models was selected for use as the viable population threshold.

(3) *Estimate Population Productivity as Indicated by a Spawner-Recruit Relationship* - The third step in the process of identifying population specific rebuilding exploitation rates is to estimate the stock-recruit parameters. Estimates of the Ricker stock-recruit parameters for each population were required for both establishing the escapement threshold levels and for the simulations of population dynamics. These parameters were estimated using methods developed by the Chinook Technical Committee (Chinook Technical Committee, in press as cited in NMFS 1999).

(4) Identify Through Simulation the Appropriate Rebuilding Exploitation Rate - The final step in determining rebuilding exploitation rates is to use a simulation model to iteratively solve for an exploitation rate that meets specific criteria that are related to both survival and recovery given the specified thresholds and estimated spawner/recruit parameters. The consultation regulations define "jeopardize the continued existence" to mean: "... to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing appreciably the reproduction, numbers, or distribution of the species" (50 CFR section 402.2).

The simulation then uses this definition - "... reduce appreciably the likelihood of survival and recovery ..." - and the population specific threshold levels to identify an exploitation rate that meets the following criteria:

(a) Did the percentage of escapements less than the critical threshold value increase by less than five percentage points relative to the baseline? *and, either*

(b) Does the escapement at the end of the 25 year simulation exceed the viable threshold at least 80% of the time? *or*

(c) Does the percentage of escapements less than the recovery level at the end of the 25 year simulation differ from the baseline by less than 10 percentage point?

The baseline condition used for comparison in this context assumes zero harvest everywhere. Said another way, these criteria seek to identify an exploitation rate that will not appreciably increase the number of times a population will fall below the critical threshold and also not appreciably reduce the prospects of achieving recovery. The rebuilding exploitation rate is the highest exploitation rate that can meet criterion (a) *and* criterion (b) *or* (c). Once identified, proposed fisheries can be evaluated by considering the likelihood that they will meet the rebuilding exploitation rates.

NMFS established rebuilding exploitation rates for 9 of the 22 populations within the ESU (Table 12). For individual populations, exploitation rates at or below the NMFS' rebuilding exploitation rates will not appreciably reduce the likelihood of survival and recovery of that population, under current conditions. NMFS' rebuilding exploitation rates were calculated from direct measures of fishing-related mortality (coded-wire tags), which were translated into FRAM

exploitation rates. FRAM exploitation rates can more easily be compared with output from fishing models currently used by the co-managers to evaluate harvest regimes.

NMFS' rebuilding exploitation rates are for individual populations. The 2003 RMP's recovery exploitation rates are for management units, which may include multiple populations. Additionally, NMFS' rebuilding exploitation rates are considered total exploitation rate ceilings. The 2003 RMP's recovery exploitation rates are expressed as either a total exploitation rate, a southern United States (SUS) exploitation rate, or a pre-terminal southern United States (PT SUS) exploitation rate (see Table 2).

NMFS' derived rebuilding exploitation rates were taken into consideration in making NMFS' no jeopardy determination for Puget Sound salmon fisheries in 2000 (NMFS 2000a) and in making the 4(d) Rule two-year determination in 2001 (NMFS 2001a). These rebuilding exploitation rates will be also used by NMFS to evaluate the 2003 RMP.

Table 12. Critical and viable escapement thresholds associated with NMFS' rebuilding exploitation rates.

Management Unit	Population	Escapement Thresholds		Rebuilding Exploitation Rates	
		Critical	Viable	Coded-Wire Tag	Fishery Regulation Assessment Modeling (FRAM)
Nooksack	North Fork Nooksack River	200	1,250	24%	17%
	South Fork Nooksack River	200	1,250	30%	21%
Skagit Summer/Fall	Upper Skagit River	967	7,454	54%	60%
	Lower Skagit River	251	2,182	33%	49%
	Lower Sauk River	200	681	36%	51%
Stillaguamish	North Fork Stillaguamish River	300	552	45%	32%
	South Fork Stillaguamish River	200	300	28%	24%
Snohomish	Skykomish River	1,650	3,500	24%	24%
	Snoqualmie River	300	-	-	-
Green	Green River	835	5,523	62%	53%

The 2003 RMP's recovery exploitation rate objectives are consistent with the rebuilding exploitation rates developed by NMFS, with possible exceptions for select populations within two management units. These exceptions are for the lower Skagit River and the upper Sauk River populations within the Skagit Summer/Fall Management Unit, and the South Fork Stillaguamish River population within the Stillaguamish Management Unit. Additionally, the total exploitation rate on the North Fork Nooksack River population within the Nooksack Management Unit is expected to exceed NMFS' rebuilding exploitation rate in 2003. The

following addresses these three management units (Skagit Summer/Fall, the Stillaguamish, and the Nooksack Management Units).

Skagit Summer/Fall Management Unit - The Skagit Summer/Fall Management Unit encompasses three populations: the upper Skagit, the lower Sauk, and the lower Skagit Rivers. All three populations are classified as Category 1 populations (see Table 4). The 2003 RMP's recovery exploitation rate ceiling for the Skagit Summer/Fall Management Unit is 52 percent. The Skagit Summer/Fall Management Unit's recovery exploitation rate ceilings were developed by the co-managers to meet the following criteria: "1) The percentage of the escapements less than the critical escapement increases by less than 5 percentage points relative to the baseline (i.e., in the absence of fishing mortality). And either: 2) Escapement at the end of 25 years exceed the recovery level at least 80% of the time; or 3) The percentage of escapements less than the recovery level at the end of 25 years differs from the baseline by less than 10 percentage points" (page 104 of the 2003 RMP). The 2003 RMP's recovery exploitation rate of 52 percent is applied to the management unit as a whole, all populations combined.

However, as mentioned earlier, NMFS' rebuilding exploitation rates are for the individual populations within this management unit. When the 2003 RMP's recovery exploitation rate ceiling for the management unit is applied to each individual population within the management unit, the 2003 RMP's recovery exploitation rate ceiling is lower than NMFS' rebuilding exploitation rate for the upper Skagit River population of 60%, but exceeds NMFS' rebuilding exploitation rates ceiling for the lower Sauk River and the lower Skagit River populations. The differences between these two exploitation rate ceilings are relatively small, 1 and 3 percentage points (Table 13).

Table 13. Comparison of the 2003 RMP's recovery exploitation rate and the NMFS' (FRAM) rebuilding exploitation rate for the Skagit Summer/Fall Management Unit.

Management Unit or Population	(A) 2003 RMP's Recovery Exploitation Rate	(B) NMFS' (FRAM) Rebuilding Exploitation Rate	(A)-(B) Difference in Percentage Points
Skagit Summer/Fall Management Unit	52%	-	-
Upper Skagit River	-	60%	-8%
Lower Sauk River	-	51%	+1%
Lower Skagit River	-	49%	+3%

Retrospective analysis indicates that the 2003 RMP's recovery exploitation rate for the Skagit Summer/Fall Management Unit, in combination with management for the critical abundance thresholds, will result in escapements above NMFS' viable thresholds for all three populations 65 percent or more of the time. In the retrospective analysis, none of the three populations fall below NMFS' lower (critical) threshold (NMFS 2001a). The percentage of the time that the viable threshold will be achieved would increase should the fisheries not harvest up to the 2003 RMP's recovery exploitation rate ceilings of 52 percent, which has been the case since 1996 (Figure 5).

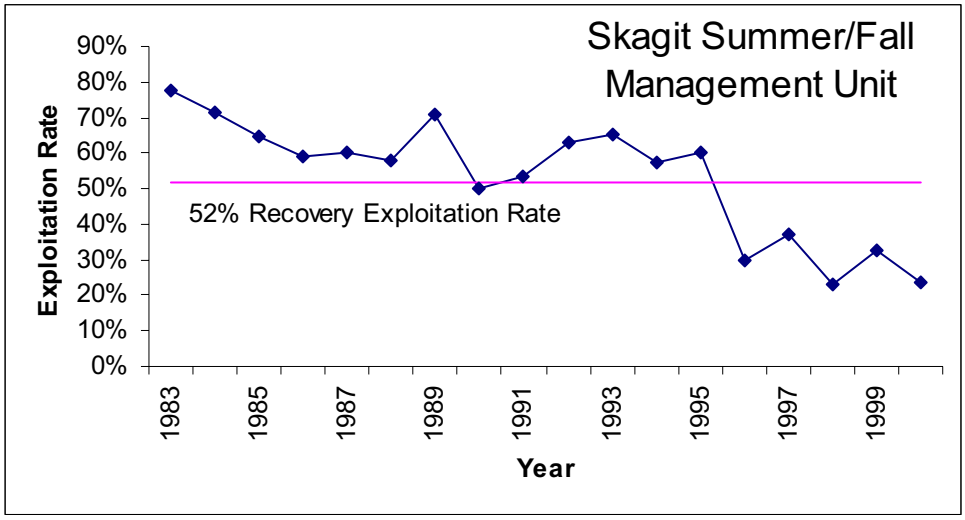

Figure 5. Total adult equivalent fisheries exploitation rate of Skagit Summer/Fall Management Units, chinook salmon, estimated from post-season FRAM model runs for management years 1983 to 2000. The 2003 RMP's recovery exploitation rate ceiling is 52% for the Skagit Summer/Fall Management Unit.

Actual implications to the lower Sauk River and the lower Skagit River populations resulting from the implementation of the 2003 RMP would depend, in part on whether the returning abundance in 2003 is above the interim escapement goal, below the interim escapement goal but above the critical abundance threshold, or below the critical abundance threshold.

If the population were to return at below the 2003 RMP's critical abundance threshold, the co-managers would impose the new lower ceiling established by the management unit's minimum fishery regime exploitation rate. The upper end of the range of expected exploitation rates for the Skagit Summer/Fall Management Unit that will result from using the 2003 RMP's minimum fishery regime is 33 percent (see Table 2), below the NMFS' rebuilding exploitation rate for the lower Sauk River and the lower Skagit River populations of 51 and 49, respectively. However, it is expected that the populations to this management unit will be above the 2003 RMP's critical abundance threshold in 2003, so the 2003 RMP's minimum fishery regime exploitation rate will not be applied by the co-managers in 2003.

The preliminary forecast of the summer/fall return to the Skagit River in 2003 of 13,700 (NMFS 2003) is above the 2003 RMP's critical abundance level, and consistent with the pre-season forecast in 2002 of 13,766, and above the pre-season forecast in 2001 of 9,290 (WDFW 2003b). In 2001, the escapement into the Skagit River for the summer/fall populations exceeded the lower thresholds for all populations, and exceeded the upper threshold for both the upper Skagit River and the lower Skagit River populations (see Table 5). All populations in the Skagit Summer/Fall Management Unit have an increasing escapement trend (see Table 6). Two of the three population's classification (lower Sauk and lower Skagit Rivers) in the management unit are considered above the lower threshold but below the upper threshold. One population's

classification (Upper Skagit River) is consistently above the upper threshold level during the recent five-year period reviewed (see Table 6). The escapement result in 2001 occurred under the 2001 RMP. The management objectives in the 2003 RMP which is being evaluated here, is very similar to those in the 2001 RMP.

The preliminary pre-season FRAM model run 1603 suggest that the total 2003 exploitation rates on the Skagit Summer/Fall Management Unit under the 2003 RMP will be at or below NMFS' rebuilding exploitation rate ceilings for the lower Sauk River and upper Skagit River populations. Therefore, no elevated level of risk is anticipated on the lower Sauk River population in 2003 due to the slightly higher recovery exploitation rate ceiling in the 2003 RMP for the Skagit Summer/Fall Management Unit, when compared to the NMFS' rebuilding exploitation rate ceilings for the individual populations.

However, the preliminary pre-season FRAM model run also suggest that the total exploitation rate in 2003 on the Skagit River Summer/Fall Management Unit of 50 percent will be above the NMFS' rebuilding exploitation rate ceilings of 49 percent for the lower Skagit River population. Additional risk to the lower Skagit River population may be expected in 2003, under the 2003 RMP, primarily due to the anticipated total exploitation rate exceeding NMFS' rebuilding exploitation rate ceiling for this population.

Stillaguamish Management Unit - The Stillaguamish Management Unit encompasses two populations: the North Fork Stillaguamish River and the South Fork Stillaguamish River. Both populations are classified as Category 1 populations (see Table 4). The 2003 RMP's recovery exploitation rate ceiling for the Stillaguamish Management Unit is 25 percent. When the 2003 RMP's recovery exploitation rate ceiling of 25 percent is applied to each individual population within the management unit, the 2003 RMP's recovery exploitation rate ceiling is lower than NMFS' rebuilding exploitation rate ceiling for the North Fork Stillaguamish River population of 32 percent (see Table 13). However, the management plan's recovery exploitation rate ceiling exceeds NMFS' rebuilding exploitation rate ceiling for the South Fork Stillaguamish population, by only one percentage points (Table 14).

The actual implication to the South Fork Stillaguamish population resulting from the implementation of the 2003 RMP depends, in part whether the returning abundance in 2003 is above the interim escapement goal, below the interim escapement goal but above the critical abundance threshold, or below the critical abundance threshold. If the population were to return below the 2003 RMP's critical abundance threshold, the management unit's minimum fishery regime exploitation rate would impose a new lower ceiling. The upper end of the 2003 RMP's minimum fishery regime expected exploitation rate for the Stillaguamish Management Unit is 16 percent, well below the NMFS' rebuilding exploitation rate for the North Fork Stillaguamish River and South Fork Stillaguamish River populations of 32 and 24, respectively. However, the preliminary forecast suggests that the return to the Stillaguamish River in 2003 of 2,050 (NMFS 2003) will be above the 2003 RMP's critical abundance level for this management unit, and consistent with the pre-season forecast return in 2002 of 2,002, and above the pre-season forecast return in 2001 of 1,400 (WDFW 2003b).

Table 14. Comparison of the 2003 RMP's recovery exploitation rate and the NMFS' (FRAM) rebuilding exploitation rate for the Stillaguamish Management Unit.

Management Unit or Population	(A) 2003 RMP's Recovery Exploitation Rate	(B) NMFS' (FRAM) Rebuilding Exploitation Rate	(A)-(B) Difference in Percentage Points
Stillaguamish Management Unit	25%	-	-
North Fork Stillaguamish River	-	32%	-7%
South Fork Stillaguamish River	-	24%	+1%

In 2001, the escapement into the Stillaguamish River for the summer/fall populations exceeded the lower thresholds for both populations, and exceeded the upper threshold in the North Fork Stillaguamish River (see Table 5). The trends for both populations in the Stillaguamish Management unit are for a stable escapement (see Table 6). The management unit has a trend of decreasing exploitation rates (Figure 6).

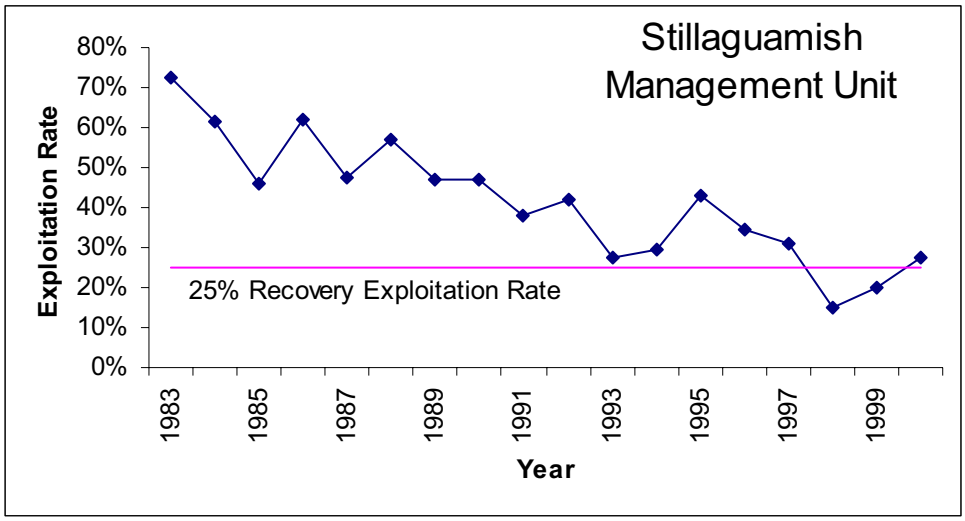

Figure 6. Total adult equivalent fisheries exploitation rates for Stillaguamish Management Unit, chinook salmon, estimated from post-season FRAM model runs for management years 1983 to 2000. The 2003 RMP's recovery exploitation rate ceiling is 25% for the Stillaguamish Management Unit.

Given the small difference (one percentage point) between NMFS' rebuilding exploitation rate ceiling and the 2003 RMP's recovery exploitation rate ceiling, past performances of the fisheries under similar conditions, the current status of the population, and based on the available 2003 forecast return, it is expected that the exploitation rate on the South Fork Stillaguamish River population will meet or fall below the NMFS' rebuilding exploitation rate ceiling for this population. The actual exploitation rate in 2003 is likely to be less than either the 2003 RMP's or NMFS' derived ceiling, given the observed exploitation rates under the 2001 RMP under circumstances similar to those expected in 2003. The preliminary pre-season FRAM model run

1603 supports the assessment that the 2003 exploitation rates under the 2003 RMP (anticipated to be 18 percent) will be at or below NMFS' rebuilding exploitation rates for these populations. There should be no elevated level of risk in 2003 due to slightly higher exploitation rate ceiling established in the 2003 RMP for the Stillaguamish Management Unit, when compared to NMFS' rebuilding exploitation rate ceiling for the individual populations within that management unit.

Nooksack Management Unit - There are two populations within the Nooksack Management Unit: the North Fork Nooksack River and the South Fork Nooksack River populations. Both populations are classified as Category 1 populations (see Table 4). During the recent five-year period (1997 to 2001), the natural-origin escapement into the North Fork Nooksack River and the South Fork Nooksack River has averaged 132 and 181, respectively (see Table 5). Both of the management unit's populations are considered increasing, but below NMFS' derived lower (critical) threshold (see Table 6). NMFS' derived lower threshold for these two populations is 200 each.

The co-managers will manage the Nooksack Management Unit under the minimum fishery regime exploitation rate ceiling in 2003. The co-managers expect that the minimum fishery regime exploitation rate in 2003 for the Nooksack Management Unit will be between five and nine percent for the southern United States fisheries (see Table 2), but the exact exploitation rate will depend on the relative abundance of the Puget Sound chinook salmon populations and the application of the fisheries described in Appendix C: Minimum Fisheries Regime of the 2003 RMP. In recent years, the Canadian fisheries account for the majority of the mortality on the populations within this management unit. On average, during the 1996 to 2000 seasons, Canadian fisheries accounted for 75 percent of the current fishery-related mortality (page 96 of the 2003 RMP). The management of Canadian fisheries is outside the jurisdiction of the co-managers.

Based on the preliminary pre-season FRAM model run[12] using the fishery regime in Appendix C: Minimum Fishery Regime of the 2003 RMP, the southern United States fisheries will be held to a below seven percent minimum fishery regime exploitation rate ceiling on the populations within the Nooksack Management Unit in 2003. This is within the 2003 RMP's expected minimum fishery regime exploitation rate range of five to nine percent (see Table 2). Although the southern United States fisheries will be held to a low 2003 RMP's minimum fishery regime exploitation rate ceiling, the total exploitation rates in 2003 is expected to exceed the NMFS' rebuilding exploitation rates for the South Fork Nooksack River population within the Nooksack Management Unit by three percentage points (Table 15), primarily because of the anticipated Canadian exploitation.

Additional risk to the North Fork Nooksack River population may be expected in 2003, under the 2003 RMP, primarily due to the anticipated total exploitation rate, in which the Canadian fisheries will account for the majority of the exploitation, exceeding NMFS' rebuilding exploitation rate ceiling for this population.

[12] Preliminary 2003 FRAM model run Apc3 dated March 20, 2003.

In summary, additional risks to the lower Skagit River and North Fork Nooksack River populations may be expected in 2003, under the 2003 RMP, primarily due to the anticipated total exploitation rate, exceeding NMFS' rebuilding exploitation rate ceiling for these populations. Preliminary pre-season FRAM model runs suggest that the total exploitation rate in 2003 on the Skagit River Summer/Fall Management Unit will be above (by one percentage point) the NMFS' rebuilding exploitation rate ceilings for the lower Skagit River population. In the case of the Nooksack Management Unit, the anticipated total exploitation rate, in which the Canadian fisheries will account for the majority of the exploitation, is expected to exceed the NMFS' rebuilding exploitation rate ceiling for this population by three percentage points.

Table 15. Comparison of the 2003 RMP's minimum fishery regime exploitation rate, the total exploitation rate in 2003 based on a preliminary FRAM model run, and NMFS' Fishery Regulation Assessment Modeling (FRAM) rebuilding exploitation rate for the Nooksack Management Unit.

Management Unit or Population	2003 RMP's Minimum Fishery Regime Exploitation Rate [1]	(A) 2003 Total Exploitation Rate based on a preliminary FRAM Model Run (FRAM Run 1603 under PFMC Option 1)	(B) NMFS' (FRAM) Rebuilding Exploitation Rate	(A) - (B) Difference in Percentage Points
Nooksack Management Unit	5 to 9% SUS	20%	-	-
N. F. Nooksack River	-		17%	+3%
S. F. Nooksack River	-		21%	-1%

1 Preliminary preseason 2003 FRAM model run Apcs, dated March 20, 2003, indicates that the 2003 Minimum Fishery Regime Exploitation Rate will be 7 percent.

Management Units Where Adequate Data were not Available

Table 16 identifies the 2003 RMP's management units where adequate data were not available to assess current productivity or analysis has not yet been completed. In these management units, the 2003 RMP establishes either a recent year, or an average of recent years, exploitation rates as the management objective.

The Green, Nisqually, and the Skokomish Management Units will be managed by the co-managers for escapement objectives. The Green River population is stable (see Table 6) and above its viable threshold in recent years. The Nisqually River has been above the critical abundance threshold, just below the viable threshold, and has shown an increasing escapement trend (see Table 5). The natural component of the Skokomish River has been above the critical abundance threshold but below the viable threshold, and has shown a stable escapement trend (see Table 5). Based on past performances of the fisheries under similar conditions, the current status of the populations, and the available 2003 return information, it is expected that the 2003

RMP will not impede these populations progress to achieving or maintaining viable thresholds as required by the 4(d) Rule (Table 16).

For the majority of the other management units where adequate data were not available to assess current productivity or analysis has not yet been completed, based on past performances of the fisheries under similar conditions, the current status of the populations, and the available 2003 forecast returns, it is expected that the one-year 2003 RMP will not impede these populations progress to achieving or maintaining viable thresholds as required by the 4(d) Rule (Table 16).

Table 16. Management units where adequate data were not available to assess current productivity or analysis has not yet been completed. This table presents their population classification and status, the 2003 pre-season forecast compared to the 2002 and 2001 pre-season forecast, and a summary of the analysis for those populations.

2003 RMP's Management Unit	**TRT's Preliminarily Recognized Populations**	**2003 RMP's Recovery Exploitation Rate**	**Population Classification** (see Table 6)	**Population Status** (see Table 6)	**2003 pre-season forecast** (NMFS 2003) **compared to the 2002 and 2001 pre-season forecast** (WDFW 2003b)	**Analysis**
Lake Washington	Cedar River N. Lake Wash. Trib.	15% PT SUS	Above the lower threshold but below the upper threshold Above the lower threshold but below the upper threshold	Stable Stable	Cedar and N. Lake Wash. Trib. Combined 2003 - 700 2002 - 1,675 2001 - 290	Based on past performances of the fisheries under similar conditions, the current status of the populations, and the preliminary 2003 return information, it is expected that the 2003 RMP will not impede these populations' progress to achieving or maintaining viable thresholds as required by the 4(d) Rule.
White	White River	20%	Above the lower threshold but below the upper threshold	Increasing	Natural: 2003 - 700 2002 - 700	Based on past performances of the fisheries under similar conditions, the current status of the populations, and the preliminary 2003 return information, it is expected that the 2003 RMP will not impede this population's progress to achieving or maintaining the viable threshold as required by the 4(d) Rule.
Puyallup	Puyallup River	50%	Above the lower threshold but below the upper threshold	- [1]	Natural: 2003 - 3,750 2002 - 2,200 2001 - 3,500	Based on past performances of the fisheries under similar conditions, the current status of the populations, and the preliminary 2003 return information, it is expected that the 2003 RMP will not impede this population's progress to achieving or maintaining the viable threshold as required by the 4(d) Rule.

Nisqually	Nisqually River	-	Above the lower threshold but below the upper threshold	Increasing	Natural: 2003 -3,100 2002 - 3,800 2001 - 1,500	In 2003, the co-managers will manage for an escapement goal of 1,100. Based on past performances of the fisheries under similar conditions, the current status of the populations, and the preliminary 2003 return information, it is expected that the 2003 RMP will not impede this population's progress to achieving or maintaining the viable threshold as required by the 4(d) Rule.
Skokomish [2]	Skokomish River	15% PT SUS	Above the lower threshold but below the upper threshold	Stable	Wild: 2003 - 2,450 2002 - 1,931 2001 - 2,080	Based on past performances of the fisheries under similar conditions, the current status of the populations, and the preliminary 2003 return information, it is expected that the 2003 RMP will not impede this population's progress to achieving or maintaining the viable threshold as required by the 4(d) Rule.
Mid-Hood Canal	Dosewallips River	15% PT SUS	Below the lower threshold	Declining	Catch Area 12B, Mid-Hood Canal, Natural 2003 - 550 2002 - 478 2001 - 360	Additional risk to the Dosewallips River population within the Mid-Hood Canal Management Unit may be expected in 2003, in part due to the lack of an individual critical abundance threshold for the Dosewallips River population to provide additional management guidance. The co-managers are committed to increasing escapement into the Mid-Hood Canal Management Unit. "Fisheries are being restricted to accommodate the escapement objective" (page 165 of the 2003 RMP). Additional more restrictive management measures will be considered by the co-managers, including closures of the Dosewallips River recreational fisheries in 2003.
Dungeness	Dungeness River	10% SUS	Below the lower threshold	Increasing	Natural: 2003 - 350 2002 - 214 2001 - 130	Based on past performances of the fisheries under similar conditions, the current status of the populations, and the preliminary 2003 return information, it is expected, as required by the 4(d) Rule criteria for populations at or below their critical thresholds, that the fishing-related mortality under the 2003 RMP on this population will not appreciably increase genetic

						and demographic risks facing this population and is be designed to permit achievement of viable functions.
Elwha	Elwha River	10% SUS	Above the lower threshold but below the upper threshold	Stable	Natural: 2003 - 2,050 2002 - 2,123 2001 - 2,130	Based on past performances of the fisheries under similar conditions, the current status of the populations, and the available 2003 return information, it is expected that the 2003 RMP will not impede this population's progress to achieving or maintaining the viable threshold as required by the 4(d) Rule.

1 Information was not available in the 2003 RMP to determine status. The 2003 RMP does state that between "1994 and 2001, escapement to the South Prairie Creek sub-basin [Index Area] has ranged from 667 to 1430 fish, averaging 1048" (see page 150 of the 2003 RMP). The 2003 RMP's upper threshold for this population is for an escapement of 500 into this index area.

2 The natural component of the Skokomish Management Unit return was examined for this analysis. The analysis did not include the hatchery return component.

Trends in exploitation rates are provided in the 2003 RMP on pages 41 and 42, or in each individual management unit's profile in Appendix A: Management Unit Status Profiles. In recent years, for most management units, total exploitation rates have been stable or declining. However, these trends are partially the results of recent Canadian fishery conservation actions.

Canadian Fisheries - Depending on the management unit, Canadian fisheries on average can account for 75 percent of the current fishery-related mortality (Table 17). The recent Canadian three-year (1998 to 2000) average exploitation rates on individual populations within the ESU have ranged from the high of 20 percent for populations in the Skagit Summer/Fall Management Unit to the low of 2 percent for the population in the White River Management Unit (NWIFC 2003).

Table 17. The average distribution of fishery-related mortality for the management years 1996 to 2000, by management unit. Canadian fisheries, on average, have accounted for over 50 percent of the fishery-related mortality in the Nooksack, Skagit Spring, Stillaguamish, and Elwha Management Units.

Management Unit	Alaska	British Columbia, Canada	Washington Troll	Puget Sound Net	Washington Recreational
Nooksack	1.6%	75.7%	1.5%	3.0%	18.3%
Skagit Summer/Fall	2.3%	43.0%	1.8%	40.2%	12.7%
Skagit Spring	1.0%	51.4%	1.2%	7.1%	39.2%
Stillaguamish	17.8%	50.3%	0.3%	2.6%	29.1%
Snohomish	1.7%	23.2%	6.2%	54.8% [1]	14.1% [2]
Lake Washington	-	-	-	-	-
Green	2.0%	29.6%	6.0%	21.7%	40.7%
White	0.0%	4.5%	0.6%	3.5%	91.4%
Puyallup	-	-	-	-	-
Nisqually	0.5%	14.5%	2.6%	44.9%	37.6%
Skokomish	1.7%	37.4%	9.0%	7.2%	44.7%
Mid-Hood Canal	-	-	-	-	-
Dungeness	-	-	-	-	-
Elwha	10.0%	69.2%	4.7%	3.8%	12.3%

[1] Puget Sound pre-terminal.
[2] Puget Sound terminal.

Canadian fisheries impacts are accounted for in this 2003 RMP or in NMFS' evaluation of the 2003 RMP. However, the management of Canadian fisheries is outside the jurisdiction of the co-managers. In recent years, Canadian fisheries have not harvested chinook salmon at levels allowed under the Pacific Salmon Treaty due to internal Canadian conservation issues. These conservation concerns, primarily pertaining to depressed west coast Vancouver Island chinook salmon and Thompson River coho salmon populations, are expected to continue in 2003 (D. Simmons, NMFS, pers. com. to D. Cantillon, NMFS, January 29, 2003). Concurrent with this restricted Canadian fishing regime, the co-managers implemented management objectives defined in the 2001 RMP to manage the U.S. fisheries during the 2001 season. The Puget Sound

chinook salmon ESU escapement results in 2001 were some of the highest observed during the recent 1998 to 2001 five-year period reviewed (see Table 5).

Preliminary information indicates that the Canadian fishery exploitation rate on Puget Sound chinook salmon was greater in 2002, when compared to 2001 (D. Simmons, NMFS, pers. com. to K. Schultz, NMFS, April 14, 2003). The co-managers implemented the management objectives in the 2001 RMP to manage the U.S. fisheries during the 2002 season. Although preliminary, the overall Puget Sound chinook salmon ESU escapement in 2002 was greater than the escapement observed in 2001 (W. Beattie, NWIFC, e-mail message to K. Schultz, NMFS, April 15, 2003).

Based on the best available information, the Canadian exploitation rate on the ESU populations in 2003, given similar abundance forecasts, will remain similar to the rates experienced in 2002. The co-managers implemented the 2001 RMP to manage the 2001 and 2002 seasons, during which time escapements were generally stable to increasing. The management measures proposed in the 2003 RMP are very similar to those included in the 2001 RMP.

For the management of the southern United States fisheries, constraining fishing-related mortality to the management objectives established in the 2003 RMP is prudent. Based on the best available information, the resulting combined overall United States and Canadian exploitation rates on these populations have contributed to stabilizing or in increasing escapements for the populations most impacted by the Canadian fisheries (Nooksack, Skagit Spring, Stillaguamish, and Elwha Management Units). Should populations fall below or be projected to fall below their critical abundance thresholds, the southern United States exploitation rates will be further reduced to the 2003 RMP's minimum fisheries regime exploitation rate ceilings (see Table 2).

Minimum Fishery Regime Exploitation Rate

The 2003 RMP imposes the minimum fishery regime exploitation rates when abundances fall below critical abundance thresholds[13]. The minimum fisheries regime exploitation rates are currently represented as a range in NMFS' evaluation and in the 2003 RMP. The actual point estimate of the minimum fishery regime exploitation rate for each management unit will depend on the forecast abundance in 2003 and its abundance relative to other salmon populations. The co-managers expect that the actual 2003 point estimate will fall within the range of minimum fishery regime exploitation rates depicted in Table 2. Similar to the 2003 RMP's recovery exploitation rate, when imposed, the 2003 RMP's minimum fisheries regime exploitation rates are ceilings.

[13] The Snohomish Management Unit's upper end of the range of expected minimum fishery regime exploitation rate of 26 percent is greater than the 2003 RMP's 24 percent recovery exploitation rate (see Table 2). The 2003 RMP's recovery exploitation rate ceiling of 24 percent is not to be exceeded. In the event that the 2003 minimum fishery regime exploitation rate is greater than 24 percent, the exploitation rate ceiling of 24 percent would remain in effect. The 2003 RMP's recovery exploitation rate of 24 percent is consistent with NMFS' rebuilding exploitation rate of 24 percent for the two populations within this management unit.

For most management units not already at the 2003 RMP's relatively low recovery exploitation rate ceilings (such as Lake Washington, Skokomish, and the Mid-Hood Canal Management Units that have a 2003 RMP's recovery exploitation rates of less then 15 percent PT SUS and the Dungeness, and Elwha Management Units that have a 2003 RMP's recovery exploitation rates of less then 10 percent SUS), the upper end of the expected 2003 RMP's ceilings established by the minimum fishery regime exploitation rates represents a reduction from the ceiling as established by the 2003 RMP's recovery exploitation rate (see Table 2). Using the upper end of the range of expected minimum fishery regime exploitation rates, this reduction in the exploitation rate ceilings for each management unit ranged from a high of a 19 percentage point reduction in the exploitation rate in the Skagit Summer/Fall Management Unit to a low of a 4 percentage point reduction in the exploitation rate for the Puyallup Management Unit (see Table 2).

Over a range of abundance, the use of the recovery exploitation rates rather than fixed escapement goals for most Puget Sound chinook salmon populations should increase the likelihood for escapement of greater numbers of adult fish, which are needed to explore population productivity and habitat capacity. Rather than always harvesting down to a set escapement level when abundance is high, a portion of the run size will always be allocated to escapement, regardless of run size. Most importantly, an exploitation rate approach is more resilient to data uncertainty and environmental variability than a fixed goal approach (Fieberg in Press).

The 2003 RMP does set escapement objectives or maximum exploitation rates for each management unit or population based on its status as required by the 4(d) Rule. Management objectives based on natural production and natural spawning have been established for the majority of Category 1 populations, and the Category 2 populations for which data is available, in the ESU. The management units with harvest management objectives at low risk of impeding population rebuilding represent the entire range of life history types and geographic distribution that comprise the ESU.

The final TRT recovery goals and delisting criteria are expected to address some of the current uncertainties in management objectives as they relate to population structure. In the meantime, the most depressed populations will be monitored to determine if they are increasing in abundance or at minimum, remaining stable. If not, NMFS would recommend that the co-managers consider more restrictive harvest management actions. However, at some of the 2003 RMP's low exploitation rate levels, it is uncertain whether additional harvest restrictions would provide any additional substantial benefit to these populations.

(4) Section (b)(4)(i)(D) Displays a biologically based rationale demonstrating that the harvest management strategy will not appreciably reduce the likelihood of survival and recovery of the Evolutionarily Significant Unit in the wild, over the entire period of time the proposed harvest management strategy affects the population, including effects reasonably certain to occur after the proposed actions cease.

The 2003 RMP's management objectives (recovery exploitation rate ceilings, interim escapement goals, critical abundance thresholds, and the minimum fishery regime exploitation rates) for Category 1 and 2 populations capture the full range of genetic diversity and life history

traits exhibited by chinook salmon populations identified by the TRT for the ESU. The 2003 RMP establishes management objectives for all Category 1 and Category 2 populations, which are based on either natural-origin production or natural spawning objectives. Where commingled hatchery-origin stocks predominate, co-managers will manage fisheries based on the need of the weakest natural population.

As required by the criteria of the 4(d) Rule, the harvest regime specified by the co-managers in the 2003 RMP takes into account the different risks facing a population depending on the status of the population: above the interim escapement goal (viable threshold); below the interim escapement goal but above the critical abundance threshold; or below the critical abundance threshold.

Based on the 1997 to 2001 five-year average escapements, there are three populations which fall into the classification of being above the viable threshold (see Table 6). Of these populations, all have stable to increasing escapement trends over the five-year period reviewed (see Table 6). The results in the last two years of the five-year period reviewed appear to be maintaining these populations above the viable threshold levels (see Table 5).

There are 15 populations which fall within the classification of being above the lower threshold but below the upper threshold (see Table 6). Of these populations, all have stable to increasing five-year escapement trends (see Table 6). Overall, escapements observed under the 2001 RMP have been some of the highest during the five-year period reviewed for populations in this classification.

There are four populations that are below their critical threshold (see Table 6). These populations are at extremely low levels. Three populations within this classification have shown an increasing five-year escapement trend (North Fork Nooksack River, South Fork Nooksack River, and the Dungeness River). The management objectives in the 2001 RMP are very similar to the management objectives in the 2003 RMP, which is being evaluated. Given similar abundance forecasts, the implementation of the 2003 RMP is expected to result in U.S. exploitation rates that are similar to those experienced in the 2001 and 2002 fishing seasons. Escapements observed in the in 2001, under the 2001 RMP have been some of the highest observed in these three systems. The stable to increasing escapement trends in these populations (North Fork Nooksack River, South Fork Nooksack River, and the Dungeness River) are expected to continue under the 2003 RMP. Thus the 2003 RMP would not appreciably increase genetic and demographic risks facing these populations. One population, the Dosewallips River, in this classification is showing a declining escapement trend. This population will be discussed below.

The management approach in the 2003 RMP further enhances the probability of survival and recovery of Puget Sound chinook salmon by being responsive to low population status. When spawning escapement is projected to fall below the critical abundance thresholds, co-managers will impose more restrictive fisheries management measures, as provided by the minimum fisheries regime exploitation rate ceiling, Appendix C: Minimum Fisheries Regime of the 2003 RMP.

Estimated impacts from the fisheries in 2003 will vary by stock, consistent with stock-specific management objectives specified in the 2003 RMP. The FRAM model run 1603 represents the anticipated exploitation rates for the various fisheries in 2003 and the projected natural escapement of Puget Sound chinook salmon by management unit (Table 18).

Table 18. Exploitation rates and natural escapement of Puget Sound chinook salmon by management unit, 2003. Estimated are based on the preliminary FRAM model run 1603, dated April 9, 2003.

Management Unit	(A) Terminal Exploitation Rate	(B) Southern U.S. Pre-terminal Exploitation Rate	(A) + (B) Southern U.S. Exploitation Rate	Total Exploitation Rate Includes (Canadian and Alaska Exploitations Rates)	Projected Natural Spawning Escapement
Nooksack	4%	3%	7%	20%	399
Skagit Sum/Fall	9%	9%	18%	50%	11,634
Skagit Spring	1%	14%	15%	24%	1,136
Stillaguamish	2%	11%	13%	18%	2,322
Snohomish	3%	12%	15%	21%	5,073
Lake Wash. (Cedar River)	10%	11%	21%	31%	307
Green	29%	11%	40%	51%	7,534
White River	8%	10%	18%	19%	1,507
Puyallup	28%	11%	39%	50%	2,392
Nisqually	41%	28%	69%	77%	1,106
Skokomish	32%	14%	46%	60%	1,347
Mid-Hood Canal	1%	14%	15%%	29%	531
Dungeness	0%	5%	5%	23%	352
Elwha	0%	5%	5%	23%	2,125

NMFS' evaluation of the 2003 RMP includes comparing the anticipated results of the implementation of 2003 RMP against either (1) NMFS' or the VSP paper's guidance critical and viable threshold standards, and (2) NMFS' rebuilding exploitation rate ceiling standards. However, it important to emphasize that this analysis is made with respect to individual populations, while the jeopardy determination is made with respect to the anticipated impacts to the ESU. For example, the failure to meet the standards for a few populations in a very large ESU does not necessarily indicate jeopardy to the ESU as a whole.

NMFS used these same standards in previous consultations and determinations to assess whether fishing under the co-managers' regulations would reduce the likelihood of survival and recovery of the Puget Sound chinook salmon ESU (NMFS 1999, 2000a, 2001a). As discussed in Section (b)(4)(i)(B)**,** starting on page 30, with the exception of the Dosewallips River population

(discussed further below), the management objectives in this one-year RMP are consistent with the population's status (as required by the 4(d) Rule) and meet NMFS' standards or the VSP paper's guidance for critical and viable thresholds.

Dosewallips River: Based on the preliminary 2003 forecast, past performance of the fishery under similar conditions, current status of the population, it is expected that the 2003 return into the Dosewallips River will continue to be below the VSP spawner abundance range guidance for a population. The escapement trend in the Dosewallips River has been declining over the four-year period reviewed (see Table 5). Additional risk to the Dosewallips River population within the Mid-Hood Canal Management Unit may be expected in 2003, in part, due to the lack of an individual critical abundance threshold for the Dosewallips River population, to provide management guidance. The recent four-year average escapement of 47 into this system represents 0.13 percent of the recent five-year combined average escapement of 36,939 into the entire ESU, as depicted in Table 5.

The Dosewallips River population is within the Mid-Hood Canal Management Unit. The characteristics of this population, including life history and run timing, are represented by the other population in the Hood Canal region and by other populations within the ESU. Additionally, the role of the undefined spawning aggregations in the adjacent Hamma Hamma and the Duckabush Rivers in recovery and their relationship with the Dosewallips River population may be clarified as further information becomes available. Because it is possible that production in the Hamma Hamma and the Duckabush Rivers may contribute to the stability of the Dosewallips River population, NMFS' assessment of the impacts of the 2003 RMP on the Dosewallips should be considered conservative. Based on these considerations, the potential higher risk that this population may be expected to experience in 2003, in this one-year harvest management plan, will not appreciably reduce the likelihood of the ESU's survival and recovery.

As mentioned earlier, NMFS has completed comprehensive analyses for a subset of Puget Sound chinook salmon populations and derived critical and viable thresholds for those populations (see Table 12). These thresholds were used by NMFS to calculate rebuilding exploitation rates. For individual populations, exploitation rates at or below the NMFS' rebuilding exploitation rate ceiling for that population will not appreciably reduce the likelihood of survival and recovery of that population, under current conditions. NMFS used these same rebuilding exploitation rate standards in previous consultations and determinations to assess whether fishing under the co-managers' regulations would reduce the likelihood of survival and recovery of the Puget Sound chinook salmon ESU (NMFS 1999, 2000a, 2001a). However, some caution is warranted since NMFS' rebuilding exploitation rates have yet to be derived for several of the Category 1 and Category 2 populations in the ESU for which data is available. These rates should be completed for use by NMFS, along with any additional results forwarded by the TRT, to evaluate future management plans.

As discussed in Section (b)(4)(i)(C) starting on page 32, with the exception of the lower Skagit River and the North Fork Nooksack River populations (discussed further below), all other populations for which NMFS has defined rebuilding exploitation rates are expected to be below the rebuilding exploitation rate ceilings in 2003. The preliminary pre-season FRAM model run

1603 supports NMFS' assessment that the 2003 exploitation rates under the 2003 RMP will be at or below NMFS' rebuilding exploitation rate ceilings for most of these populations.

Lower Skagit River: The preliminary pre-season FRAM model run 1603 suggest that the total exploitation rate in 2003 on the Skagit River Summer/Fall Management Unit will be approximately 50 percent, 1 percentage point above the NMFS' rebuilding exploitation rate ceilings of 49 percent for the lower Skagit River population. The difference between these two ceilings is very small. Under the 2001 RMP, the lower Skagit River population has exhibited an increasing escapement trend (see Table 6). The population's classification is considered to be above the lower threshold but below the upper threshold. The recent five-year average escapement is near the upper threshold (see Table 5). The Skagit River is located in the north Puget Sound region. The characteristics of this population, including life history and run timing, are represented by other populations in the region and by other populations within the ESU.

The management objectives of the 2003 RMP are very similar to the management objectives in the 2001 RMP. In 2001, the escapement into the Skagit River for the summer/fall populations exceeded the lower thresholds for all populations, and exceeded the upper threshold for the lower Skagit River population (see Table 5). The preliminary forecast of the summer/fall return to the Skagit River in 2003 of 13,700 (NMFS 2003) is above the 2003 RMP's critical abundance level, and consistent with the pre-season forecast in 2002 of 13,766, and above the pre-season forecast in 2001 of 9,290 (WDFW 2003b).

Based on the past performances of the fisheries under similar conditions, the current status of the populations, and the preliminary 2003 return information, the anticipated exploitation rate on the lower Skagit River within the Skagit Summer/Fall Management Unit in 2003 will not appreciably reduce the likelihood of the ESU's survival and recovery.

North Fork Nooksack River: Additional risk to the North Fork Nooksack River population may be expected in 2003. Under the 2003 RMP the anticipated total exploitation rate, in which the Canadian fisheries will account for the majority of the exploitation, is anticipated to exceed NMFS' rebuilding exploitation rate ceiling for this population. The exploitation rate in 2003 is expected to exceed NMFS' rebuilding exploitation rate ceiling for this population by three percentage points (see Table 15). The North Fork Nooksack River population's classification is considered to be below the lower threshold, but has shown an increasing trend in escapement (see Table 6). The 4(d) Rule criterion for populations at or below their critical thresholds is that the fishing-related mortality under the 2003 RMP on these populations must not appreciably increase genetic and demographic risks facing these populations and be designed to permit achievement of viable functions, unless the plan demonstrates that the likelihood of survival and recovery of the entire ESU in the wild would not be appreciably reduced by greater risks to that individual population.

There are two populations within the Nooksack Management Unit: the North Fork Nooksack River and the South Fork Nooksack River populations. Both populations are classified as Category 1 populations (see Table 4). The number of reported strays between the South Fork and North Fork Nooksack River populations is fairly large (see page 18 of NMFS 2001b). However, it is difficult at this time to discern whether the fish moving between the forks are expected to

influence one another's population or extinction dynamics. Length-at-age of fish from the two streams is not significantly different. Additionally, Kendall Creek hatchery (North Fork Nooksack River) stocks are also listed under the ESA. Production from the Kendall Creek hatchery contributes extensively to the abundance and return of the North Fork Nooksack River population. The 1997 to 2001 five-year average spawning escapement into the North Fork Nooksack River is 680 when hatchery-origin production is considered (Table 1, page 94 in Appendix A of the 2003 RMP). This is compared to the five-year average natural-origin spawning escapement of 132 mentioned earlier (see Table 5). This hatchery-origin production adds additional buffer to the risks to this population in the short term.

All U.S. fishery-related mortality in 2003 on the North Fork Nooksack River population will be incidental, taken in fisheries targeting other healthy populations or species. Given the anticipated Canadian exploitation rate, essentially the entire southern United States exploitation rate on this population would have to be eliminated (i.e., reduced to less than 4 percent), to achieve the NMFS' rebuilding exploitation rate ceiling of 17 percent for this population. Based on the preliminary pre-season FRAM model run 1603, seventy-four percent of the SUS fishery-related mortality to the Nooksack River populations in 2003 is anticipated to occur in treaty Indian fisheries. NMFS, as a matter of policy, based primarily on treaty obligations, has sought not to entirely eliminate harvest, instead accepting potential, slight increased risk to the species to provide limited fishery opportunity. This approach is particularly important to the tribes, recognizes their treaty rights and NMFS' trust responsibility (NMFS 2002c). The treaty tribes have a right and priority to conduct their fisheries within the limits of conservation constraints. Because of the Federal government's trust responsibility to the tribes, NMFS is committed to considering the co-managers' judgment and expertise when it comes to the conservation of trust resources. However, the opinion of the co-managers and their immediate interest in fishing is balanced against NMFS responsibilities under ESA. Based on these considerations, NMFS concludes that the 2003 RMP Nooksack Management Unit's minimum fishery regime exploitation rate that would be imposed on the southern United States fisheries in 2003, in this one-year 2003 RMP, achieves this balance.

For management units where adequate data were not available to assess current productivity or analysis has not yet been completed for a rebuilding exploitation rate, the 2003 RMP establishes either a recent year, or an average of recent years, exploitation rates as the management objective. These exploitation rates appear to have resulted in stable to increasing escapement trends for most populations under current environmental conditions.

In summary, the 2003 RMP's management objectives incorporate, and are consistent with, the best available scientific information on the population structure of the Puget Sound chinook salmon ESU. As discussed above and in previous sections of the Evaluation and Recommended Determination, NMFS' analysis on the implementation of the 2003 RMP identifies the likelihood that 19 of the 22 populations within the ESU will meet NMFS' or the VSP paper's guidance standards. NMFS' analysis of the implementation of the 2003 RMP also identifies the likelihood that that 3 populations (Dosewallips River, the lower Skagit River, and the Nooksack River) will not meet NMFS' or the VSP paper's guidance standards. Based on the considerations discussed above, the potential, slightly higher risk that these populations may be expected to experience in 2003, in this one-year harvest management plan, will not appreciably reduce the likelihood of the

ESU's survival and recovery. Overall, the management objectives in the 2003 RMP are protective of the geographic, life history, and diversity of the ESU. Therefore, NMFS Northwest Region's Sustainable Fisheries Division concludes that the implementation of the one-year 2003 RMP will not appreciably reduce the likelihood of survival and recovery of the ESU in the wild.

(5) Section (b)(4)(i)(E) Includes effective (a) monitoring and (b) evaluation programs to assess compliance, effectiveness, and parameter validation *(Minimum requirement: collect catch and effort data, information on escapements, and information on biological characteristics, such as age, fecundity, size and sex data, and migration timing*).

The Puget Sound Indian Tribes and the Washington Department of Fish and Wildlife, independently and jointly conduct a variety of research and monitoring programs. Chapter 7 of the 2003 RMP (starting on page 58) describes these monitoring programs which are used to assess effectiveness of the management actions in achieving the management objectives of the RMP and to validate the assumptions used in deriving the objectives. This information is used in conjunction with the performance indicators to assess the effectiveness of the 2003 RMP.

Chinook salmon harvest in all fisheries, including incidental catch and fishing effort, is monitored by the co-managers. Commercial catches within the Puget Sound Action Area are recorded on sales receipts ('tickets'), copies of which are sent to the Washington Department of Fish and Wildlife and tribal agencies and recorded in a jointly-maintained database. A preliminary summary of catch and effort is available four months after the season, though a final, error-checked record may require a year or more to develop.

For Puget Sound fishing areas, recreational harvest is estimated from either creel census or from a sample of catch record cards obtained from anglers. The recreational fishery baseline sampling program provides auxiliary estimates of species composition, effort, and catch-per-unit-effort (CPUE) to the Salmon Catch Record Card System. The baseline sampling program is geographically stratified among the marine catch areas in Puget Sound. For this program, the objectives are to sample 120 fish per stratum for estimation of species composition, and 100 boats per stratum for the estimation of CPUE.

Catch and effort summaries allow an assessment of the performance of fishery regulations in constraining catch to the desired levels. Time and area constraints, and gear limitations, are imposed by regulations, but with some uncertainty regarding their exact effect on harvest. For many management units, catch is often projected pre-season based on the modeled effect of specific regulations. Post-season comparison to actual catch assesses the true effect of those regulations, and guides their future application or modification.

Incidental mortality in fisheries directed at other species or non-listed chinook salmon has comprised an increasingly large part of the total harvest mortality of Puget Sound chinook salmon. Non-landed mortality is accounted for in this RMP. Non-landed mortality is primarily addressed in the 2003 RMP's Chapter 4, the section on Non-Landed Fisheries Mortality (staring on page 36) and in Appendix B: Non-landed Mortality Rates. Non-landed mortality is projected by averaging a recent period, either as total chinook salmon landed or as a proportion of the target species catch.

The co-managers estimate chinook salmon escapement from surveys in each river system. Escapement surveys provide information on run timing and population status. A variety of sampling and computational methods are used to calculate escapement, including cumulative redd counts, peak counts of live adults, cumulative carcass counts, and integration under escapement curves drawn from a series of live fish or redd counts. A more detailed description of methods used for Puget Sound systems is included in Appendix E: Puget Sound Chinook Escapement Estimates: Description and Assessment of the 2003 RMP.

Catch sampling and escapement surveys also provide biological data on age, length, sex, and size. Depending on the accuracy required of such estimates, more sampling effort may be required by the co-managers than has previously been expended on gathering basic biological data to determine age and sex composition and the effects of fisheries on these biological elements. State and tribal technical staffs are currently focusing attention on the design and implementation of these studies.

The performance of the 2003 fisheries will be assessed to determine the extent to which catch and fishing effort conform to the quotas, ceilings, or projections that were defined in pre-season planning for each fishing area and season. This assessment may lead to further evaluation of the effectiveness of fishing regulations, (i.e. time or area constraints, gear restrictions, or bag limits) in future management plans. The causes of discrepancies between expected and actual catch and effort will be identified by the co-managers with a view to changing regulatory measures, and methods for projecting catch and fishing effort, to improve their accuracy.

Assessment of the total 2003 return requires accurate estimation of escapement and reconstruction of fishing-related mortality from coded-wire tag data or fishery simulation models. There will a time lag of approximately 18 months, after the conclusion of the fall fisheries, before tag recovery data are available to researchers. Tag recoveries from all intercepting fisheries, including those in Alaska and British Columbia, are required to complete this assessment. Accounting of the harvest fishing-related mortality and escapement for each management unit will enable the calculation of exploitation rates, which may be compared with the pre-season projections and objectives. Ultimately, reconstruction of all cohorts associated with a given brood year enables the calculation of brood-year exploitation rates.

Cohort reconstruction and estimation of exploitation rates from tag recovery data will also provide a means of assessing the accuracy of the 2003 fishery simulation models. Models predict unit-specific fishing-related mortality by scaling the abundance of all contributing populations, and the fishing effort anticipated in each area and season, against those in a base period. Tag-based run reconstruction provides an alternative and independent estimate of the total harvest fishing-related mortality and harvest distribution of each management unit or population. The errors detected in the simulation model, whether they be associated with abundance forecasts or computation of harvest, will be quantified so that fishery management planning will be robust to those errors.

Cohort reconstruction for each management unit is the fundamental monitor of productivity. As discussed above, the productivity (i.e. freshwater and marine survival) of each management unit

or population guides the development and adjustment of exploitation rate objectives. Those objectives must conform to the most recent values and trends in population productivity. However, it takes longer to collect sufficient data for productivity to detect changes. Periodically, the population/recruit function will be updated, and the recovery exploitation rate and thresholds re-assessed, for each management unit. The tasks involved in monitoring abundance and productivity, and assessing the performance of annual fishing regimes, is mandated by the Puget Sound Salmon Management Plan (PSSMP 1985).

In addition to the monitoring programs discussed in the 2003 RMP, there are numerous other ongoing projects funded by other agencies or programs which provide additional information useful for fisheries management. Each year, the Salmon Recovery Funding Board provides funding for projects designed to further salmon recovery. Limiting factor analyses are being conducted for each major watershed within Washington State (WSCC 2000). The results of these analyses will be important for parameter validation and management objective revision as necessary. Data collection and monitoring programs included in Hatchery and Genetic Management Plans implemented within the Puget Sound region will also provide valuable information on stray rates and patterns, and contribution of hatchery fish to escapements.

(6) Section (b)(4)(i)(F) Provides for (a) evaluating monitoring data; and (b) making any revisions of assumptions, management strategies, or objectives that data show are needed will be made.

A description of how Washington Department of Fish and Wildlife and the Puget Sound tribes will evaluate the monitoring data and compile a report of the findings for the 2003 season can be found in Chapter 7 of the 2003 RMP, in the Annual Chinook Management Report section, and in Appendix E: Puget Sound Chinook Escapement Estimates: Description and Assessment of the 2003 RMP.

State and tribal technical staff will meet periodically during the 2003 season to exchange information and data, achieve consensus on in-season management actions, and prepare post-season reports. Additional meetings and exchanges will occur as needed to develop recommendations for management units' harvest regimes pertinent to this RMP, resolve differences in approach, and review monitoring program results. Data from the monitoring programs form the basis for development and refinement of forecasting and assessment efforts.

The co-managers will notify NMFS when in-season actions are expected to increase an exploitation rate to a management unit's ceiling rate or lower the expected escapement level to a management unit's critical abundance threshold (page 49 of the 2003 RMP). The notification will include a description of the change, an assessment of the anticipated fishing mortality resulting from the change, and an explanation of how impacts of the action maintains consistency with the Puget Sound chinook salmon harvest management plan.

Post-season review of the 2003 management plan is part of the annual pre-season planning process. This post-season review is necessary to permit an assessment of the co-managers' annual management performance in achieving spawning escapement, harvest, and allocation objectives. The co-managers review population status annually and, where needed, identify

actions required to improve estimation procedures and correct bias. As appropriate, measures will be derived to address deleterious effects on size, age or sex selectivity. Such improvements provide greater assurance that management objectives will be achieved in future seasons. This effort builds a remedial response into the pre-season planning process to prevent excessive fishing-related mortality levels relative to the conservation of a management unit.

The 2003 post-season reports will be completed by mid-February of 2004 (page 58 of the 2003 RMP). The review of the 2003 harvest management plan will include: a fisheries summary; harvest levels; non-landed mortality; estimated escapement; an exploitation rate assessment; and the cohort reconstruction. It will also include consideration of the information developed through the recovery planning efforts of the TRT. Future revisions to the Puget Sound chinook salmon management plan will occur if comprehensive technical review of the available information indicates that a modification would be beneficial to achieving the goals of the 2003 RMP. The results of the 2003 post-season report will also be used to shape future fishery management plans in order to increase the effectiveness of the harvest regime and decrease uncertainty. Escapements will be monitored to evaluate whether the exploitation rates have contributed to stabilizing escapements.

(7) Section (b)(4)(i)(G) Provides for (a) effective enforcement, (b) education, (c) coordination among involved jurisdictions.

The description of the 2003 RMP's enforcement and education programs can be found in Chapter 5, in the section on enforcement and education, starting on page 49.

The RMP relies on a pre-season planning process to set the initial harvest regimes (fishing schedules and seasons) for all management units. The setting of the 2003 Puget Sound fisheries schedules and seasons occurs concurrently with the planning of the Washington and Oregon coastal fisheries. The 2003 pre-season planning process will occur from March through early-April, during the North of Cape Falcon forums (WDFW 2003a). This forum is open to the public, allowing the public access to salmon status information, and providing the public an opportunity to interact with the co-managers.

Regulations enacted during the season will implement guidelines established during the pre-season planning process described above, but may be modified based on in-season assessments of effort, catch, abundance, and escapement. However, in many areas, the co-managers lack the necessary tools to detect in-season deviations from the pre-season forecast in time to adjust regulations. Any in-season modifications will be in accordance to the procedures specified in the Puget Sound Salmon Management Plan (PSSMP 1985) and subsequent court orders.

The Washington Department of Fish and Wildlife and individual Treaty tribes are responsible for regulation of harvest in fisheries under their authority, consistent with the principles and procedures set forth in the Puget Sound Salmon Management Plan. Fisheries will be regulated to achieve sharing and production objectives based on four fundamental elements: (1) acceptably accurate determination of the appropriate exploitation rate, harvest rate, or numbers of fish available for harvest; (2) the ability to evaluate the effects of specific fishing regulations; (3) a means to monitor fishing activity in a sufficient, timely and accurate fashion; and (4) effective

regulation of fisheries to meet objectives for spawning escapement and fishery impact limitations.

Commercial fishery regulations are promulgated by Washington Department of Fish and Wildlife and by each tribe. The co-managers maintain a system for transmitting commercial fishing regulations electronically to all interested parties (including NMFS), in a timely manner, prior to and during all fisheries. Regulations are stored in paper and electronic format by Washington Department of Fish and Wildlife, each tribe, and the Northwest Indian Fisheries Commission. Commercial fishery regulations for some fisheries are also available through telephone hotlines maintained by Washington Department of Fish and Wildlife, the Northwest Indian Fisheries Commission, and individual tribes. Washington Department of Fish and Wildlife publishes regulations for recreational fisheries in a widely distributed pamphlet. Washington Department of Fish and Wildlife regulations, and in-season regulation changes, are also published on their website (www.wa.gov/wdfw).

Non-Indian commercial and recreational fishery regulations are enforced by Washington Department of Fish and Wildlife. The Washington Department of Fish and Wildlife Enforcement Program currently employs 163 personnel. Of that number, 156 are fully commissioned Fish and Wildlife staff who ensure compliance with licensing and habitat requirements, and enforce prohibitions against the illegal taking or poaching of fish and wildlife (WDFW 2003c). The Fish and Wildlife Enforcement Program is primarily responsible for enforcing the Washington State Fish and Wildlife Code. However, officers are also charged with enforcing many other codes as well, and are often called upon to assist their local city/county, and other state law enforcement agencies, and tribal authorities. On average, officers currently make more than 300,000 public contacts annually. Washington Department of Fish and Wildlife Enforcement staff also works cooperatively with the U.S. Fish and Wildlife Service, the NMFS Enforcement branch, and the U.S. Coast Guard.

Each tribe exercises authority over enforcement of tribal commercial fishing regulations, whether fisheries occur on or off their reservation. In some cases enforcement is coordinated among several tribes by a single agency (such as the Point No Point Treaty Council, which is entrusted with enforcement authority over Lower Elwha Klallam, Jamestown S'Klallam, and Port Gamble S'Klallam tribal fisheries). Enforcement officers of one tribal agency may be cross-deputized by another tribal agency, where those tribes fish in common areas. Prosecution of violations of tribal regulations occurs through tribal courts and governmental structures.

The co-managers maintain a system for transmitting, cross-indexing and storing fishery regulations affecting harvest of salmon. Both Washington Department of Fish and Wildlife and the Puget Sound Tribes monitor and enforce compliance with these regulations as part of more extensive enforcement programs. The co-managers' and federal court systems are expected to be sufficient to ensure that enforcement is followed through with appropriate prosecution of violators.

The Puget Sound treaty tribes and Washington Department of Fish and Wildlife have direct management authority over fisheries harvesting Puget Sound chinook salmon in Puget Sound. The Pacific Salmon Commission, Pacific Fishery Management Council, and North of Falcon

meetings in 2003 will provide the forums for coordination among jurisdictions impacting Puget Sound chinook salmon populations. The fishery regimes developed each year as an outcome of these planning forums account for fishing-related mortality in all fisheries in the United States and Canada. They also help to ensure that fisheries are consistent with the management objectives and approach described in the 2003 RMP. Consistent with this aim, the 2003 RMP's recovery exploitation rate objectives for the Puget Sound chinook salmon management units will be submitted to the Pacific Fishery Management Council for inclusion into the federal management plan for West Coast salmon fisheries. Fishing-related mortality of Puget Sound chinook salmon in Canadian and Alaskan fisheries is constrained by the terms of the current Pacific Salmon Treaty agreement (PST 1999).

Both the Pacific Fishery Management Council and North of Falcon fishery planning processes are open to the public. The Council takes public comment and input throughout its development of fishing regimes for the ocean fisheries off Washington, Oregon and California. Representatives from the commercial and recreational fishing constituencies are active participants in the North of Falcon planning process. Public notification of fishery regulations is achieved through press releases, regulation pamphlets, telephone hotlines, and Federal Register notices. The Washington Department of Fish and Wildlife has recently implemented a more aggressive campaign to increase public involvement and education through expanded public meetings, and greater access to information through use of the Internet.

(8) Section (b)(4)(i)(H) Includes restrictions on resident and anadromous species fisheries that minimize any take of listed species, including time, size, gear, and area restrictions.

The 2003 RMP's recovery exploitation rate, interim escapement goal, and the critical abundance threshold are the primary elements of the harvest plan. Time, size, gear and area and retention restrictions are all among the actions taken to ensure that salmon fishing-related mortality is consistent with these management objectives. Fisheries have become increasingly restricted. Chinook salmon-directed fisheries in some terminal areas have been closed for years, and in other areas, fisheries on other species and healthy hatchery populations are restricted or delayed to protect naturally spawning chinook salmon.

Actions the co-managers have taken in the past and will be considered in 2003 to protect listed species include: closures in the April, May, and June recreational fisheries and size limits to protect spring chinook salmon; closed spawning grounds to fishing; and required non-retention of chinook salmon. Both commercial and recreational fisheries have instituted closures around river mouths where chinook salmon concentrate before moving upstream.

Juvenile yearling life stage spring chinook salmon are not typically vulnerable to being caught in the fisheries by this RMP because of the juvenile's feeding habits and small size. Juvenile chinook salmon are rarely caught in any Puget Sound fishery. Nets are the primary commercial gear used in Puget Sound and the mesh is generally too large to ensnare juveniles.

Recreational fisheries in areas throughout Puget Sound have regulations that will reduce the potential mortality to juvenile chinook salmon. These regulations include the use of barbless hooks, minimum size requirements, and catch and release only fishing. Puget Sound freshwater

salmon recreational fisheries are concentrated during the period of adult return (July, August, September, and October) typically well after the majority of juveniles have emigrated from freshwater.

(9) Section (b)(4)(i)(I) Is consistent with other plans and conditions established within any Federal court proceeding with continuing jurisdiction over tribal harvest allocations.

The 2003 RMP explicitly states in its general principles that it will comply with the requirements of *U.S. v. Washington, U.S. v. Oregon,* other applicable federal court orders, and in the Pacific Salmon Treaty.

Notice of Determination

As required in section 223.203(b)(6)(iv) of the ESA 4(d) Rule, the Secretary of Commerce will publish notice of his determination as to whether the RMP appreciably decreases the likelihood or survival and recovery of affected threatened Puget Sound Salmon Management Plans, together with a discussion of the biological analysis underlying that determination.

Recommended Determination

The 2003 RMP's management objectives incorporate, and are consistent with, the best available scientific information on the population structure of the Puget Sound chinook salmon ESU. NMFS' analysis on the implementation of the 2003 RMP identifies the likelihood that 19 of the 22 populations within the ESU will meet NMFS' or the VSP paper's guidance standards. NMFS' analysis of the implementation of the 2003 RMP also identifies the likelihood that that three populations (Dosewallips River, the lower Skagit River, and the Nooksack River) will not meet NMFS' or the VSP paper's guidance standards. Based on the considerations discussed in Section (b)(4)(i)(D), the potential, slightly higher risk that these populations may be expected to experience in 2003, in this one-year harvest management plan, will not appreciably reduce the likelihood of the ESU's survival and recovery. Overall, the management objectives in the 2003 RMP are protective of the geographic, life history, and diversity of the ESU. Therefore, NMFS Northwest Region's Sustainable Fisheries Division concludes that the implementation of the one-year 2003 RMP will not appreciably reduce the likelihood of survival and recovery of the ESU in the wild.

It is the recommendation of NMFS, Northwest Region's Sustainable Fisheries Division, that the 2003 RMP dated February 19, 2003, and titled "Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component," provided by the Puget Sound Treaty Tribes and the Washington Department of Fish and Wildlife, be determined to adequately address all of the criteria established for Limit 6 of the ESA 4(d) Rule for the listed Puget Sound chinook salmon Evolutionary Significant Unit, and be found to not appreciably reduce the likelihood of survival and recovery of the Puget Sound chinook salmon ESU.

Literature Cited

Baxter, R.D. 1991. Chinook Salmon Spawning Behavior: Evidence for Size-Dependent Male Spawning Success and Female Mate Choice. M.S. Thesis, Humboldt State University, Arcata, California

Berejikian, B. A, E.P. Tezak, and A.L. LaRae. 2000. Female Mate Choice and Spawning Behavior of Chinook Salmon Under Experimental Conditions. J. Fish Biology 57: 647-661.

Bishop, S., and A. Morgan (eds.). 1996. Critical habitat issues by basin for natural chinook salmon stocks in the coastal and Puget Sound areas of Washington State. Northwest Indian Fisheries Commission, Olympia, WA, 105p.

Bisson, P.A. and R.E. Bilby. 1998. Organic matter and trophic dynamics. *in*: Naiman R.J. and R.E. Bilby, editors. 1998. River ecology and management: lessons from the Pacific Coastal Ecoregion. Springer-Verlag. 696 pages.

Gresh, T, J. Lichatowich, P. Schoonmaker. 2000. An estimation of historic and current levels of salmon production in the Northeast Pacific ecosystem. Fisheries. Volume 25(1), pages 15-21.

Fieberg, J. In Press. Role of model and parameter uncertainty in assessing harvest strategies. Northwest Indian Commision, 6730 Martin Way E., Olympia, WA 98516. 42 pages

Hard. J. 2002. Case study of Pacific salmon. In U. Dieckmann, O. R. Godø, M. Heino, and J. Mork, eds. Fisheries-induced adaptive change. Cambridge Univ. Press, Cambridge (*in press*).

Heath, D. D., G.K. Iwama, and R.H. Delvin. 1994. DNA fingerprinting used to test for family effects on precocious sexual maturation in two populations of *Oncorhynchus tshawytscha* (Chinook salmon). Heredity 73:616-624.

Heath, D.D., C.W. Fox, and J.W. Heath. 1999. Maternal effects on offspring size: variation through early development of chinook salmon. Evolution 53(5): 1605-1611.

Healey, M. C. 2001. Patterns of gametic investment by female stream- and ocean-type chinook salmon. Journal of Fish Biology 58:1545-1556

Healey, M. C.and W.R. Heard. 1984. Inter- and Intra-Population Variation in the Fecundity of Chinook Salmon (Oncorhynchus tshawytscha) and its relevance to Life History Theory. Can. J. Fish. Aquat. Sci. 41: 476-483

Larkin, G.A. and P.A. Slaney. 1996. Trends in marine-derived nutrient sources to south coastal British Columbia streams: impending implications to salmonid production. Watershed

Restoration Management Report No. X. Province of British Columbia, Ministry of Environment, Lands and Parks and Ministry of Forests. 356 pages.

Meyers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

Murota, T. 2002. The marine nutrient shadow; a global comparison of anadromous salmon fishery and guano occurrence. American Fisheries Society Symposium XX: 000-000.

Murphy, M.L. 1998. Primary production. *in*: Naiman R.J. and R.E. Bilby, editors. 1998. River ecology and management: lessons from the Pacific Coastal Ecoregion. Springer-Verlag. 696 pages.

Naiman, R.J., S.R. Elliott, J.M. Helfield and T.C. O'Keefe. 2000. Biophysical interactions and the structure and dynamics of riverine ecosystems: the importance of biotic feedbacks. Hydrobiologia. Volume 410, pages 79-86.

National Marine Fisheries Service (NMFS). 1999. Endangered Species Act - Reinitiated Section 7 Consultation - Biological Opinion - Approval of the Pacific Salmon Treaty by the U.S. Department of State and Management of the Southeast Alaska Salmon Fisheries subject to the Pacific Salmon Treaty. Issued on November, 18, 1999. 90 pages.

NMFS. 2000a. Endangered Species Act – Reinitiated Section 7 Consultation. Biological Opinion - Effects of Pacific Coast Ocean and Puget Sound Salmon Fisheries During the 2000-2001 Annual Regulatory Cycle. National Marine Fisheries Service, Protected Resources Division. p. 96

NMFS. 2000b. Viable salmon populations and the recovery of evolutionarily significant units. NOAA Technical Memorandum NMFS-NWFSC-42.

NMFS. 2001a. Joint State Tribal RMP Provided by the Washington Department of Fish and Wildlife and the Puget Sound Tribes for Salmon Fisheries Affecting Puget Sound Chinook Salmon Under Limit 6 of the 4(d) Rule - Determination Memorandum. April 27, 2001. 22 pages plus one attachment.

NMFS. 2001b. Independent populations of chinook salmon in Puget Sound. Puget Sound Technical Recovery Team Public review draft dated April 11, 2001. 52 pages.

NMFS. 2001c. Untitled letter from the Puget Sound Technical Recovery Team to Dear interested party, dated April 17, 2001. 2 pages.

NMFS 2002a. ESU viability criteria for the Puget Sound chinook Evolutionarily Significant Unit. Draft dated December 19, 2002. The Puget Sound Technical Recovery Team. 11 pages.

NMFS, 2002b, Independent populations of chinook salmon in Puget Sound. Puget Sound TRT Final Draft. April 8, 2002. 62 pages.

NMFS. 2002c. National Marine Fisheries Service Endangered Species Act (ESA) section 7 biological opinion consultation and the Magnuson-Stevens Act essential fish habitat consultation, Chief Joseph Dam tailrace fishery from 2002 through 2012. Issued December 19, 2002. 38 pages.

NMFS. 2003. Preliminary 2003 Puget Sound Summer/Fall Chinook 4B Preseason Forecast. Fax from D. Simmons, NMFS to K. Schultz, NMFS. February 24, 2003. 3 pages.

Pacific Salmon Treaty (PST). 1999. The Pacific Salmon Agreement, signed between the United States and Canada, June 30, 1999. Pacific Salmon Commission. Vancouver, British Columbia.

Peterman, R.M. 1977. A simple mechanism that causes collapsing stability regions in exploited salmonid populations. J. Fish. Res. Board Can. 34: 1130-1142.

Peterman, R.M. 1987. Review of the components of recruitment of Pacific Salmon. American Fisheries Society Symposium 1: 417-429.

Polis, G.A., W.B. Anderson and R.D. Holt. 1997. Toward an integration of landscape and food web ecology. Annual review of ecology and systematics. Volume 28, pages 289-316.

Puget Sound Indian Tribes (PSIT) and Washington Department of Fish and Wildlife (WDFW). 2001. Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component. March 23, 2001. 47 pages plus appendices.

Puget Sound Indian Tribes (PSIT) and Washington Department of Fish and Wildlife (WDFW). 2003. Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component. February 19, 2003. 239 pages including appendices.

Puget Sound Salmon Management Plan (PSSMP). 1985. *United States vs. Washington* 1606 F.Supp. 1405. 42 pages.

Puget Sound Salmon Stock Review Group (PSSSRG). 1997. An assessment of the status of Puget Sound chinook salmon and Strait of Juan de Fuca coho stocks as required under the Salmon Fishery Management Plan. Pacific Fishery Management Council Review Draft, 78 p. (Available from the Pacific Fishery Management Council, 2130 Fifth Ave., Ste. 224, Portland, OR 97201.)

Ricker, W. E. (1972). Hereditary and Environmental Factors Affecting Certain Salmonid populations. The Stock Concept in Pacific salmon. R. C. Simon and P. Larkin. Vancouver, Mitchell Press Limited: 19-160.

Simenstad CA. 1997. The relationship of estuarine primary and secondary productivity to salmonid production: bottleneck or window of opportunity? In: Emmett RL, Schiewe MH, editors. Estuarine and ocean survival of Northeastern Pacific salmon: proceedings of the workshop. NOAA Technical Memorandum NMFS-NWFSC-29: U.S. Department of Commerce. p 133-145.

Silverstein, J.T., and W.K Hershberger. 1992. Precocious maturation in coho salmon (*Oncorhynchus kisutch*): estimation of the additive genetic variance. J. Heredity 83: 282-286.

Washington Department of Fisheries (WDF), Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. 1993. 1992 Washington State salmon and steelhead stock inventory (SASSI). Wash. Dep. Fish Wildl., Olympia, 212p. + 5 regional volumes.

Washington Department of Fish and Wildlife (WDFW). 2003a. Preseason salmon forecast meeting March 3 begins WDFW's annual season-setting process. New Release, Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501-1091. February 7, 2003. 2 pages.

WDFW. 2003b. 2001 and 2002 preseason forecasts for select Puget Sound chinook salmon populations. E-mail message form B. Sanford, WDFW to K. Schultz, NMFS, on March 18, 2003. 7 pages.

Washington Department of Fish and Wildlife (WDFW). 2003c. Information obtained from the Washington Department of Fish and Wildlife, Enforcement web site at http://www.wa.gov/wdfw/enf/enforce.htm. Website was accessed on February 16, 2003.

Washington Department of Fish and Wildlife (WDFW) and Northwest Indian Fisheries Commission (NWIFC). 2003. White River chinook harvest objective. Memorandum from L. Lavoy (WDFW) and A. Rankis (NWIFC) to WDFW and tribal fisheries management staff. February 14, 2003. 2 pages

Northwest Indian Fisheries Commission (NWIFC). 2003. Exploitation rates and escapement for select Puget Sound chinook salmon stocks. Information obtained from W. Beattie, NWIFC, to S. Bishop, NMFS. E-mail message with attachments dated February 27, 2003. 6 pages.

Washington State Conservation Commission (WSCC). 2000. Salmon and Steelhead Habitat Limiting Factors Resource Inventory. Washington State Conservation Commission. Olympia, Washington. Volumes 1-5.

Wipfli, M.S., J. Hudson and J. Caouette. 1998. Influence of salmon carcasses on stream productivity: response of biofilm and benthic macroinvertebrates in southeastern Alaska, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences. Volume 55, pages 1503-1511.